THE

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"ELECTRICAL REVIEW."

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	Page
The Incorporated Municipal Electrical Association	125
The Development of the Current Interrupter (*illus.*) (*continued*)	127
Compounded Asynchronous Machinery (*illustrated*) (*continued*)	128
Legal	130
Parliamentary	133
Correspondence	137
Regenerative Tramcar Control (*illustrated*)	138
Business Notes	139
Hydro-Electric Power Stations in Italy (*illustrated*)	143
City Notes	152
Stocks and Shares	154
Share List of Electrical Companies	155
Market Quotations	156
Electric Tramway and Railway Traffic Receipts	156
Modern Views on Matter: The Realisation of a Dream (*concluded*)	157
Municipal Tramways Association...	158
The Incorporated Municipal Electrical Association:—	
Electric Traction as Applied to the Newcastle Tramways	159
Management and Working of Boilers	160
Some Statistics of Electricity Supply	161
The Possibilities of Future Economies in Electrical Illumination	162
Some Sub-station Dangers and their Prevention	162
Selection and Training of Motormen and Conductors ...	163
Our Legal Query Column	164
New Patents Applied For	164
Published Specifications	164

THE

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THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

THE address of the President of the Convention at Sunderland indicates a troubled mind, "municipal trading," like Banquo's ghost, disturbing the banquet; but the annual interchange of opinion between the municipal engineers and the chairmen of committees no doubt affords a useful summary of the constant discussions between them during the year.

That the municipal engineers, as a body, ably perform their technical duties is beyond dispute; as Mr. Snell admits, they have nothing to do with politics, but unfortunately they suffer from them in having their work controlled by circumstances of an abnormal character.

The Engineer President of the Convention devotes the bulk of his paper to a discussion upon municipal ways and means—a comparison between the working of trading companies and what is poetically described as "The municipalisation of certain public necessaries"—questions of accountancy involved in the provision for depreciation, antiquation, obsolescence and the numerous contingencies to which the new industry is liable. Mr. Snell feels the disadvantage of municipalities whose governing powers are limited to certain defined areas, undertaking business like that of electricity supply and tramways, which (especially under modern developments) can be most successfully worked over districts embracing the areas of numerous local authorities—he pines for "free and wise expansion," and the removal of unnecessary restrictions. As to the latter complaint, the companies have suffered more severely than municipalities, owing to the powers of veto exercised by local authorities, besides the restrictions common to both.

In endeavouring to compare the working of municipalities and companies, both Mr. Snell and Mr. Alderman Smith (chairman of the Electricity Committee of Barrow-in-Furness) deal with figures which practically prove nothing.

The cost of erecting and equipping electricity supply stations cannot be dealt with in the dogmatic way adopted in the papers read at the Convention, the figures being apparently taken from the well-known tables of one of our contemporaries. They assume that because Corporations have constructed works at a cost of £92 per kilowatt as against £106 by companies, therefore municipalities show better results!

In the same way the cost of production and the prices at which consumers are charged are compared, with a view of showing that the management is better carried out by local authorities than by companies.

All such comparisons are largely fallacious, unless the circumstances of each case can be shown to be comparable. Neither municipalities nor private companies are likely to pay more for their plant than market prices, but the character of the machinery, &c., may differ essentially; so

also with cost of production, as pointed out in Alderman Smith's paper: "There are very many factors which have an important bearing on this, but the three which are usually considered to have the greatest influence on costs are output, load factor and cost of fuel."

It is only necessary to compare the differences stated in Table IV*e*. in Alderman Smith's paper, where he shows that at Liverpool, with an output of 20,018,142 units and a load factor of 24·23, the total costs are more (1·00d.) than in the case of Bolton, where the output is only 3,120,709, the load factor 17·81, and the costs only ·96d.

As to the relative prices charged to consumers, the comparisons put forward are equally fallacious, and are not even based upon the alleged total costs; thus, according to the latest edition of the tables employed by Mr. Alderman Smith, Bolton with a cost of ·81d., obtains 3·15d. per unit, against 2·81d. obtained by the Corporation of Stafford, where the total costs are 2·19d.

Mr. Snell states in a sweeping way that the "companies spent 25 per cent. more on plant, charged 41 per cent. more per unit, and their costs were nearly 34 per cent. in excess of the costs of the municipal undertakings," and he complacently adds that this "answers the attacks which have been made upon municipal electrical undertakings during the last year." These comparisons and assertions are not only valueless, but are evidence of the weakness of the case advocated by the combination of municipal engineers and chairmen of committees in the papers read at the Convention.

In dealing with the trading results, it would be more interesting to have an explanation of the principle upon which the public lighting, say, for example, at Salford, is charged by the Corporation at 3·33d. per unit, the total costs being 2·19d. Accepting these figures, it would appear that the ratepayers are being charged a profit upon the public lighting of 1·14d. per unit. It is well known that the deficiency in some Corporation accounts has been made up wholly or in part from profits on public lighting, which is tantamount to transferring the loss from one pocket to another.

The address of Mr. Snell and the paper of Mr. Alderman Smith deal usefully with depreciation of municipal electrical undertakings, upon which the question of profit and loss on the trading materially turns. The attempt to dispose of the provision for depreciation by claiming that it is covered by the sinking fund, has completely broken down.

Mr. Snell says, in his paper, "Some of our plant (such as accumulators) has a natural life of only 10 or 11 years, some 25 to 30 years, and some 50, 80 or 100 years. A sinking fund which repays a debt in 25 years is a clumsy and unsound instrument for writing off plant which is non-existent in the eleventh year, under existing conditions, although the 25 years is supposed to represent the 'equated' life of the whole of the installation. The present method of the Board in such a case is to grant a further loan for the replacement of this portion of the plant, for which they grant a period of 10 years. The result is that from the eleventh to the twenty-first year a twofold sinking fund on this particular plant has to be paid, and then, in the twenty-first year, the plant again is non-existent, and a third loan has to be applied for."

When it is further remembered that no portion of any sinking fund can be legally applied for any purpose other than payment of original cost of plant, it is obvious that the sinking fund cannot be a provision for depreciation.

Mr. Snell endeavours to meet the difficulty by suggesting that "Each application for a loan should be subjected to an inquiry of the Board of Trade so as to ensure that respectable schemes only were submitted, and it should be compulsory upon the municipal authority to set aside an additional sum (over and above the sinking fund thereby entailed) of 1½ per cent. of the value of the capital expenditure, commencing not later than two years after such expenditure had been made, to form a depreciation fund."

We cordially endorse this opinion, which admits in principle our contention that the sinking fund cannot provide for depreciation, the only difference between us being as to the amount to be set aside, and from what date this reserve should be created. We suggest that it should not be less than 3 per cent. per annum from the date of starting the works. If the gross profits do not admit of this provision, Mr. Snell suggests payment of the deficiency out of the rates, or the adoption of what is known as the Bermondsey arrangement—viz., to raise the charge for energy supplied.

We must reserve our notes upon the discussion of the papers until next week.

Radiation from the Human Body.

Some time ago we noticed a sensational report which appeared in the daily papers that Prof. Goodspeed, of the University of Pennsylvania, had discovered that some kind of radiation capable of making an impression on a photographic plate was given off by the human body. It appears from an account of Prof. Goodspeed's experiments, published in the *Scientific American*, that there is nothing very new about the discovery, as, indeed, Prof. Goodspeed himself admits. The so-called discovery amounts to this, that when the human body or any other object is exposed for some time to the Röntgen rays, it becomes itself a source of radiation, which is capable of affecting a photographic plate. This phenomenon had previously been observed and investigated by Perrin and Sagnac, Guillon, Townsend and others. Goodspeed has improved on his predecessors by experimenting in the dark and shutting off all optical fluorescence. He succeeded in producing secondary radiograms in the dark from bodies previously exposed to the X-rays. While sleeping in the room where his experiments had been carried out, Prof. Goodspeed developed an aggravated attack of inflammation of the eyes, which he traced to the secondary radiation from the objects in, and from the walls of, the room. He considers that the inflammation arising from long exposure to X-rays may perhaps be explained in the same way as being due to secondary emanations, and not to the direct rays.

Radium and Helium.

The suggestion was made some time ago that helium was probably one of the products of the disintegration of radium. This conclusion was suggested by the fact that helium is found in minerals containing radio-active substances. Pitchblende, the mineral from which radium is extracted, contains helium; and helium is also found in minerals containing other radio-active materials, such as uranium and thorium. Now that it has been shown that a certain percentage of the atoms of

radium and thorium are continually breaking up into smaller particles, this process in the course of time might be expected to produce some new element in sufficient quantity to be detected by the ordinary chemical analysis. The suspicion that helium was a product of the atomic disintegration of radium has been confirmed in a remarkable manner by some recent spectroscopic experiments. A paper has been received by the Royal Society from Sir William and Lady Huggins, in which they describe experiments by which they have shown that a radium salt gives a spectrum of eight definite lines, four, and perhaps five, of which agree with lines in the helium spectrum. To obtain the spectrum of radium it was necessary to use a wide slit and to make a 72 hours' exposure on a photographic plate. A remarkable confirmation of Sir W. and Lady Huggins's experiments has simultaneously been obtained by Sir William Ramsay. Speaking at the annual dinner of the Society of Chemical Industry, he said he had been examining the emanation of radium, and the result of the examination was to show the whole spectrum of helium. There was no doubt, he said, of the continual production of helium from radium. It has long been known that helium is present in the gaseous atmosphere of the sun. In the light of these new discoveries, this suggests that radium may be present in considerable quantity in the sun. An interesting calculation bearing on this question appears in *Nature*, July 9th. Mr. W. E. Wilson calculates that 3·6 grams of radium per cubic metre of the sun's volume would generate sufficient heat to account for the whole of the sun's radiation. He suggests that it may be possible that at solar temperatures radium is capable of much more energetic radiation, and if so, the 3·6 grams might be reduced to a much smaller figure.

University College, London.

We have received an appeal on behalf of engineering education and research at University College, London, from the chairman, Sir A. R. Binnie, and the hon. secretary and treasurer, Mr. Leslie S. Robertson, of the Committee which has been formed to promote the equipment and endowment of the Engineering Department. The past history of engineering education at the College shows that it has taken a leading part in the teaching of engineering science. As long ago as 1828 it recognised the necessity for teaching the scientific principles of engineering, and instituted the first Chair of Engineering. It was here, too, that the first engineering laboratory in this country was opened, by Dr. A. B. W. Kennedy, in 1878, and many distinguished engineers have received their scientific training at the College. We cannot too heartily commend this appeal to the notice of our readers; the necessity for the adequate equipment and endowment of the Engineering Department of the University of London, of which this College will form one of the most important sections, is too obvious to require demonstration, and we trust that the response will be immediate and generous. In order to effect the desired improvements in the departments of mechanical and electrical engineering, it is estimated that a sum of £85,000 will be necessary; of this, £20,000 will be devoted to increasing the accommodation and equipment, while the remainder will provide an annual income of about £1,900, which will be expended in salaries and current expenses. The sum is a modest amount—a trifle, compared with the magnificent donations of individuals to colleges abroad; it is to be hoped that our great engineering firms will not pass by this opportunity of practically acknowledging their indebtedness to the great teachers of the past, who carried on their work in the face of innumerable difficulties, and brought about results of the utmost benefit to engineering science in this country.

THE DEVELOPMENT OF THE CURRENT INTERRUPTER.

By J. WRIGHT.

(*Continued from page* 44.)

Grimsehl's mercury interrupter is also of a novel type, and is represented as simply as possible in fig. 11. It consists of an organ pipe, P, arranged in the path of a stream of water through the tube, T, the direction of flow being indicated by the arrows. The vibrating reed, R, set in motion by the flow of water, carries a platinum extension, *p*, which dips into the mercury bath Hg, the level of the mercury in which can be adjusted by means of the cock, C, and reservoir, *r*. D is a vertical stand-pipe, branching from the tube, T, and containing a volume of air, which imparts the necessary elasticity to the flow of water. A wash bottle (not shown in the figure) is introduced at a point in the circulatory system to collect any mercury which may be carried over by the water. Little or no wear is experienced at the platinum, owing to the cooling effect of the water, and the rate of interruption is very steady: but, on the other hand, it is impossible with this form of apparatus to obtain a much higher frequency than 100 per second.

We now come to a consideration of one of the most important scientific inventions of later years—viz., the electrolytic interrupter. Electrolytic interrupters, generally speaking, may be divided into two classes, according to whether their design follows that of Wehnelt or of Caldwell. The general principle underlying the action of both types of apparatus is the same; but whereas in the former the actual interruption takes place at the submerged extremity of the

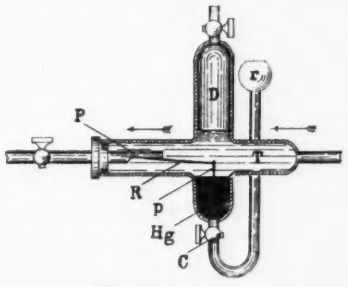


Fig. 11.

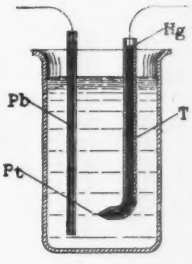


Fig. 12.

smaller of two dissimilar electrodes, immersed in the same mass of electrolyte, in the latter the electrodes, usually alike, both as regards dimensions and the material of which they are composed, are immersed respectively in two separate masses of the same electrolyte, separated by a partition pierced by a small hole under the surface of the liquid, at which point the interruptions take place.

The Wehnelt electrolytic interrupter, invented by Prof. Wehnelt, of Charlottenburg, was first formally introduced to public notice and described in detail by Mr. A. A. Campbell Swinton at a meeting of the Institution of Electrical Engineers, held March 9th, 1899, and again at a meeting of the Physical Society held on the following day. The form of apparatus there exhibited consisted of a glass containing vessel, in which was placed a fairly large cylindrical lead cathode. The anode, or positive terminal, consisted of a platinum wire about $\frac{3}{4}$ in. in length, projecting outwards from the shorter arm of a J-shaped ebonite tube, supported vertically in the glass vessel. The latter was filled with a dilute solution of sulphuric acid (1 in 5). The device replaces the ordinary mechanical interrupter in the primary circuit of a coil, and produces a very powerful secondary discharge, the current through which is almost unidirectional. In Mr. Swinton's original experiments before the Physical Society a voltage of 25 was the minimum at which the apparatus would work. The platinum wire must be actually immersed in the electrolyte before switching on the current or the action will not start, and, moreover, there is considerable capacity at the terminals of the interrupter, which enables the user to dispense with the ordinary tin-foil condenser as an adjunct to the induction coil.

D

Prof. Wehnelt's earlier form of interrupter consisted (fig. 12) of the usual containing vessel (in this case a beaker) and electrolyte, in which were immersed the two electrodes, the negative, or cathode, Pb, being a plate of lead, and the anode a short piece of platinum wire, Pt, fused into the lower extremity of a glass tube T, external electrical connection with the platinum being obtained by means of a column of mercury Hg in the glass tube itself, the upper portion of which took the place of a mercury cup, the amalgamated extremity of the connecting wire being immersed therein. Glass is objected to by many experimenters, for this purpose, on account of its liability to fracture at the lower, or sealed extremity, owing to the great amount of heat evolved at the anode. The fluid mercury connection has also been dispensed with by some users, who solder the connecting wire directly on to the platinum, though, in one respect, at least, the mercury form of connection is advantageous in that it assists in keeping down the temperature of the anode.

The Wehnelt interrupter will work with either a direct or alternating current supply to the primary, and, by its means, frequencies of interruption running into 1,000 or more per second are readily obtainable, as against the 40 to 60 per second maximum attainable with the ordinary mechanical form of interrupter. The frequency varies to a certain extent with the primary voltage of supply, and also with the inductance in the circuit.

Prof. Silvanus Thompson has demonstrated an improved regularity of interruption by this device if a jet of air be caused to pass rapidly in front of the anode, whilst active.

Prof. J. A. Fleming suggests an anode consisting of a platinum tip, welded to a copper wire, and passing down the centre of a porcelain tube, fitted at its lower extremity with an ebonite stopper or end-piece, through which the platinum passes.

The Wehnelt electrolytic interrupter may also be worked in multiple form, several platinum anodes being grouped together in the same bath or electrolyte. Mr. E. W. Marchant, of the Blythswood Laboratory, Renfrew, N.B., described such a one in the *Electrician* some four years ago, as having given satisfaction in use at that institution. The cathode was, as usual, of lead, and itself formed the box, or containing vessel, some 8 in. long by 3 wide and 6 deep. The anodes were six in number, and consisted of platinum wire, ·018 in. in diameter, passing tightly through ebonite plugs in the lower extremities of a series of glass tubes, the length of platinum projecting from the tube being about $\frac{1}{10}$th of an inch. External connection was obtained by means of copper wires silver-soldered to the platinum, and brought to terminals on the base of the instrument. The remaining space in the glass tubes was subsequently filled in with soft wax.

D'Arsonval prefers a form of Wehnelt interrupter consisting of a test tube with a platinum wire introduced through its base, as anode, and he also asserts that potash may be substituted for the dilute sulphuric acid electrolyte, and iron for the lead cathode.

A modification of the Wehnelt electrolytic interrupter, suggested by J. Von Pallich, has both its electrodes constructed of wire, the cathode being copper, and the anode steel. Both wires are surrounded by glass tubes, that encircling the anode, or steel wire, being specially strong, and embracing it closely at the lower extremity. The anode is from one to two millimetres in diameter, is led up the glass tube, and passes through a cork at the top, which is cupped to contain mercury, and serves as a means of connection to the remainder of the apparatus. The electrolyte is dilute sulphuric acid as usual, and the outer vessel is immersed in a cold water bath with the object of preventing overheating and "fatigue," a phenomenon common to all interrupters of the Wehnelt class, and one which temporarily stops the action. It is stated that, with this modified liquid interrupter, the steel wire or anode wears away at the point of exit from the glass tube, and not over the whole surface of the exposed extremity. Moreover, the double adjustment rendered possible by the two wires considerably simplifies the process of regulation, and enables any desired current strength to be speedily obtained.

The constructional principle of the Caldwell form of electrolytic interrupter has already been briefly dealt with, and it will be unnecessary to refer to it further, except in connection with such modifications as involve the main constructional features of it, or of both leading types of liquid interrupter.

(To be continued.)

COMPOUNDED ASYNCHRONOUS MACHINERY.

By G. HOOGHWINKEL, M.I.E.E.

(*Continued from page* 123.)

The practical application of the above principle is quite easy. Either a secondary winding of few coils is put on in addition to the squirrel-cage rotor winding and connected to

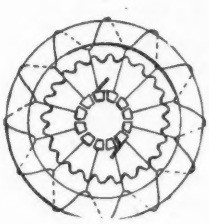


Fig. 2.

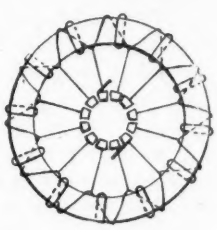


Fig. 1.

the commutator (fig. 1), or the rotor winding is short-circuited through a ring of conductors, which is connected to the commutator, as well as the excitation winding (fig. 2). The best way is to use a commutator in which the segments are connected by copper strips.

This second construction has the advantage of being simpler, and also that the copper strips connecting the commutator segments prevent all sparking at the brushes. This winding is, therefore, nothing else than an ordinary

Fig. 3.

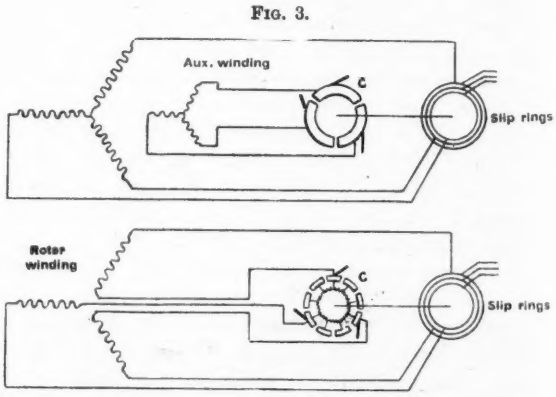


Fig. 4.

direct current winding, but has the disadvantage of additiona shunt losses in the copper strips. To avoid these losses for the greater part, a three-phase winding has been introduced, which will be described later on. When used on motors with slip-rings, the two systems of auxiliary winding are as shown in fig. 3 and fig. 4, the latter being the most used.

The segment connections have also the advantage of doing away with the current pulsations in the rotor winding and giving a constant field. These pulsations exist in an ordinary direct current as well as in a three-phase winding. They are always caused by the commutation of polyphase currents of a certain periodicity which produce a field of another periodicity. They generate a back E.M.F. in the rotor winding which may equal the pressure at the brushes. The segment connections now act as dampers against these pulsations, just as damping coils on generators act against hunting. This is also one of the reasons why the commutator need not have many segments, but only a sufficient number to prevent direct connection between two brushes.

The segments simply replace the short-circuiting ring of an ordinary squirrel-cage motor.

In the accompanying diagram (fig. 5) the compensating current even falls with the load. This shows that the induced rotor current does *not* pass through the brushes, as might be

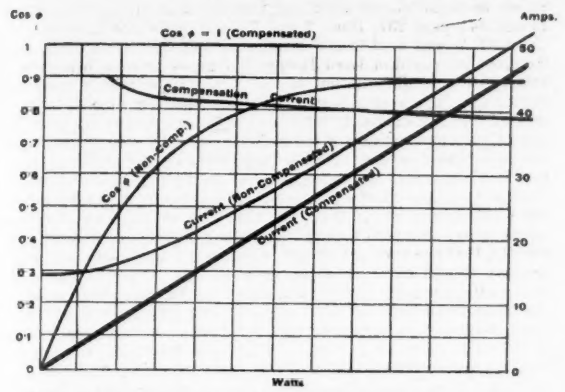


Fig. 5.—12-h.p. Motor Compensated for cos $\phi = 1$.

imagined, for otherwise the current through the brushes would *rise* with the load.

These curves, taken from actual practice, show the result of careful compensation: cos $\phi = 1$ even at no-load and overload. They also show the absence of armature reaction. The compensating current remains almost the same for all loads.

Now, as regards the mechanical construction of compensated asynchronous machines, it must be remembered that the field ampere-turns have to be added to the rotor windings and substracted from the stator windings. We have, therefore, in the rotor a smaller number of larger slots, and in the stator smaller slots. Also, the *overload capacity* is, of course, affected by this difference between the two machine types. In the asynchronous compensated motor the rotor field, which limits the overload capacity, is equal to stator field + leakage field, while in ordinary synchronous machines it is equal to the stator field — leakage field. It is easy to strengthen the rotor field by allowing more leakage, the iron losses in the rotor being very small.

The commutator is, as we have seen before, a small and simple item (about 5 to 10 per cent. of the surface of an ordinary commutator of the same output).

The number of segments in a continuous current machine depends, first, on the pressure and current between two segments short-circuited by the brushes; and, secondly, on the pressure of the commutator current at the passage of the brushes from one segment to another. In asynchronous machines the same considerations hold good for the number of segments, if we neglect the effect of the *short-circuited* rotor winding. For we may consider the alternating current as a continuous current for the moment the brush passes from one segment to another, and the pressure of the coil between these two segments at that moment limits, just as with a continuous machine, the number of segments per pole. But in our asynchronous machine the coil between the two segments is short-circuited (squirrel-cage winding), and the pressure, therefore, is annulled. Hence we are able to allow a much higher pressure, or a much smaller number of segments per pole than with a continuous-current machine.

The number of brushes is fixed by the number of phases, so a three-phase compensated machine has only three brushes. If also *compounded*, three more brushes for the main current have to be added. The minimum number of segments is therefore 3 or 6 segments per pole. With larger machines, when we want to reduce the excitation current (which passes through the brushes) we have about 10 to 12 segments per pole, which number is still very small.

The three-phase rotor winding is connected to the commutator at 3 or 6 points, and in multipole machines the corresponding segments are connected through Mordey connections.

We have already referred to the different types of rotor windings. The ordinary direct current winding (fig. 6) has the advantage that in any position relative to the brushes, the coils are included in the brush circuit. But as in any continuous current armature, we have the pulsations

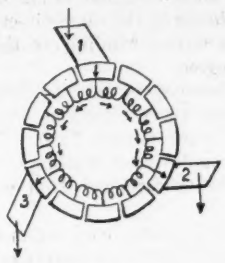


Fig. 6.

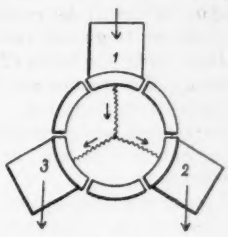


Fig. 7.

resulting from the commutation. It is easy to get an idea of these pulsations by imagining the brushes to revolve round the commutator and marking the current in the different coils. In the same way as in direct current machines, these pulsations can be reduced by augmenting the number of segments, which, however, is a disadvantage. As remarked before, the self-induction caused by these pulsations (with a frequency of three or four times the supply frequency) results in losses.

In a three-phase winding (fig. 7) the pulsations are very pronounced, and the current can even become 0, but does not change direction. In both cases the pulsations are proportional to the frequency of the supply, and the number of poles, and decrease with the number of segments. They are damped, however, by the segment connections which short circuit the rotor windings. The short-circuited currents generated in these connections damp the E.M.F. generated by the pulsations proportionally to the resistance of the connections.

But the losses due to these segment-connections are also proportional to their resistance. They are:—(1) Excitation losses; (2) shunt losses in the connections (shunt to brush circuit); (3) the slip. For (1) and (3) the resistance should be reduced, and for (2) augmented. The objection to a

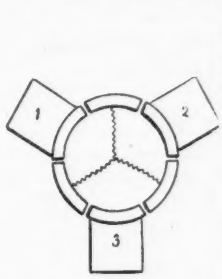


Fig. 8.

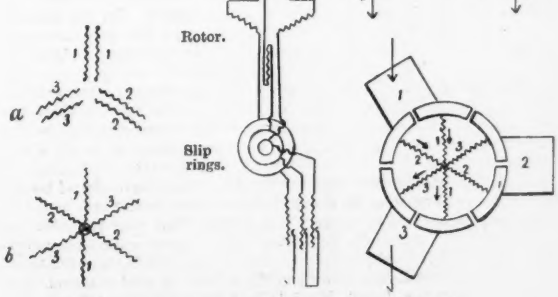


Fig. 10. Fig. 9. Fig. 11.

direct-current winding is therefore the shunt losses in the segment connections. These segment connections are not shown in the drawings.

In a three-phase winding (fig. 7) we see that the rotor windings are always short-circuited by the brushes except at one moment (fig. 8) where the segment connections form the circuit. This moment can be reduced as much as possible

by carefully choosing the width of brushes and segments. Losses (1) and (3) are therefore of no account, and we are able to augment the resistance of the connections to do away with the losses under (2).

The rotor winding is *always* short-circuited in *the same* three points, and the current is *always* in the same direction. The objections to the continuous current winding are therefore reduced to a much smaller degree.

If we make the width of the brushes the same as the distance on the commutator between two connections, we can reduce the interruption of the brush circuit to 0. The latter arrangement is suitable for multi-phase machines, as it gives wide brushes, and we are able to distribute them on the commutator.

The simple three-phase winding is mostly used for motors with slip-rings. The three phases (fig. 9) are connected at one end to the slip-rings and at the other to the commutator. During starting the commutator is the neutral point, during the running the short-circuited slip-rings.

The winding which is most used for compensated and compound generators is a three-phase winding with parallel branches, which combines the advantages of the continuous current winding, viz.: small excitation and slip losses, with the advantage of the three-phase winding, viz.: doing away with the shunt losses through the segment connections. Each phase consists of two parallel branches, which are connected to two stars but in opposite directions (fig. 10).

Two opposite branches are always wound in the same slot, so there is no self-induction, the latter being annulled by the mutual induction of the other opposite branch as long as one half of the winding is a circuit. This happens when the brushes pass from one segment to the next. (Fig. 11.) Therefore there are no pulsations, and the segment connections could be dispensed with. They are retained, however, against sparking, but they may be of ample resistance, and thus do away with the shunt losses, as seen above.

(*To be concluded.*)

LEGAL.

Patent Exploitation, Ltd., v. The American Electrical Novelty and Manufacturing Co., Ltd.

(*Concluded from page* 87.)

On Wednesday, June 24th, Mr. Justice Buckley delivered judgment as follows:—In January, 1902, there was tried before myself an action brought by the present plaintiffs, the Patent Exploitation, Ltd., against Siemens Bros. & Co., Ltd., as defendants. In December, 1902, that action was heard upon appeal, and resulted in finding the plaintiffs' patent invalid, and the defendants to be guilty of infringement. On February 4th, 1903, the action in which I am now about to give judgment was brought by the same plaintiffs against other defendants, the American Electrical Novelty and Manufacturing Co., Ltd. The present defendants have defended the action upon every point which was decided against defendants in the previous action, claiming, as they are entitled to do, that the decision in that action is not binding upon them. In the former action the defendants relied upon five anticipations—Newton, Thiebaut, Webb Jensen, Bender and Castle-Smith. In the present action the defendants have relied upon some 14—the same five anticipations, and some nine others, which the previous defendants did not set up. The present defendants have also set up prior users, and have adduced different and further evidence as to the state of knowledge at the date of plaintiffs' patent, and as to the electrical and physical conditions of the battery which are relevant to the matter under inquiry. Under these circumstances it is my duty, guided by the decision in the Court of Appeal, to decide this action upon the larger materials which these defendants have placed before me. For the purpose of so doing, it is essential, in the first instance, that I should ascertain, as exactly as I can, what was the decision of the Court of Appeal in the prior case. I must state that, as my starting point, and subject to any alteration in the facts established by the present evidence, I must guide myself by that decision. The patent sued on is a patent No. 1,110, of 1890, for improvements in galvanic batteries. For the purpose of identifying the passages in the judgments of the Lords Justices to which I am about to refer, I give reference to the 20th volume of the Reports of Patent Cases. I find that the Court of Appeal affirm that the principles involved in galvanic batteries were old, page 234, line 32; that every one of the ingredients mentioned by the patentee had, before his patent, been used in galvanic batteries, page 239, line 16; that the electrolytes had been used in every physical state described or referred to in the specification, page 239, line 18; that the novelty of the invention consisted in the application of old principles in a particular and effective manner, page 234, line 34; and that the patent contained good subject matter, because it claimed a combination of known ingredients so arranged as to satisfy defined conditions, page 239, line 10; and the combination of the ingredients in the manner and form pointed out in the specification was new, page 239, line 24; page 239, line 38; page 241, line 37. Further, by a majority, Lord Justice Cozens-Hardy dissenting, the Court of Appeal held that the patentee had indicated pulverisation of the manganese and carbon as essential, and held that that was a novelty, page 239, lines 14 and 44; page 237, lines 2 and 7; and page 238, line 54. The Court of Appeal held that the claim—I take this more particularly from the judgment of Lord Justice Stirling—was not to a galvanic battery of defined form, but one of a particular type, namely, one having two layers of material, both semi-solid or plastic, both permeated by the excitant, but one only containing depolarising agents, plus any ingredients, which comply with the limitations of the above requirements. Those limitations were considerable, and involved, first, that the materials must be capable of being reduced to such a state as that, when mixed with water, they take a semi-solid or plastic form. Secondly, that the depolariser should be confined to one layer, thereby excluding liquid depolarisers; and thirdly, that the excitant should permeate both layers, and consequently should not act injuriously on the depolarising agents. In deciding that the patentee insisted on pulverisation as asked, the Court were, as it appears to me, led to that conclusion by the fact established, as they held by the evidence before them that the pulverisation must be carried to such an extent that the water is held up by capillary attraction. To ensure that liquid be held up by means of capillary attraction, it is not necessary that all the materials should be reduced to a fine powder. It is sufficient that there be in the material a sufficient amount of fine powder; the rest of the material may be granular. Concisely put, I think that the Court of Appeal held, first, that the patentee insisted upon pulverisation—that is, the reduction to a fine powder—of all carbon and manganese, and that this was new; and, secondly, that the patentee discovered and disclosed an application of known principles in a particular and effective manner, and that the combination which he described was good subject matter. In this judgment I propose to deal with the above two points severally, and to inquire whether, upon the evidence of prior users and anticipations adduced by the present defendants, they have displaced the conclusions of fact upon which the judgment of the Court of Appeal was based. First, then, I take the question of pulverisation. In the previous action the evidence was (and Mr. Swinburne, who was called for the defendants, admitted that, so far as he knew, the fact was) that pulverisation was new in 1890. The present defendants have proved that that is not the case. Mr. Swinburne, who again has been called for the defendants, has told me that, upon a further study of the subject, he is satisfied that in the previous case he was, in that question of fact, mistaken. The fact is that, long before 1890, the question of pulverisation of carbon and manganese for the purpose of the inner layer had been the subject of experiment in detail. Beetz, before 1882, wrote an article detailing the result of experiments which he had made. That paper is dealt with in "Wiedemann Electricité," Vol. 1, of 1882, on pages 751-2, where the results of the experiments are detailed, and the following result is stated as thereby shown:—"Therefore, the cells provided with fine carbon powder or fine manganese peroxide powder are useless, both on account of the rapid change in E.M.F., and in the case of the latter, on account of the magnitude of the rapidly increasing resistance. On the other hand, the cells with coarse carbon and fine manganese peroxide powder are to be recommended." From the evidence in this case I have learned that the conditions of the problem are as follows:—In this mixed mass of manganese and carbon it is desirable to ensure two things, conductivity, which is increased by giving an easy path for the current through the carbon, and depolarisation, which is increased by having, everywhere, carbon in close proximity to the manganese. Conductivity is assisted by leaving the carbon in comparatively large grains, for the resistance is less in passing through a lump or large grain of carbon which is comparatively tightly compressed, than through a light bulk of powdered carbon which is relatively less compressed. But, on the other hand, depolarisation is increased by having the particles of carbon everywhere in contact with a particle of manganese. The latter, therefore, is a compromise between these two, and the result of Beetz's experiment was that the best results are arrived at when the carbon is coarse and the manganese fine. This question of pulverisation, therefore, had been the subject of scientific investigation and a statement of results which was published knowledge before the plaintiffs' patent. If, by pulverisation, the patentee meant, as I think the Court of Appeal held him to mean, the reduction of all the carbon and manganese to a fine powder, his step in insisting on that was a retrograde, and not a forward, step. If, on the other hand, he meant the pulverisation of some, leaving the other in granular form, then he was anticipated by Beetz. Further, in 1885, there is a patent of Jensen—that is to say, Hellesen—dealing with the constitution of the inner or black layer. That patentee insists on the employment of depolarising ingredients in the form of a fine powder which is to surround the cathode, and then is to be firmly compressed, and his claim is for the application and employment of the materials which he describes in the form of a fine powder firmly pressed on to the cathode. If, therefore, by pulverisation the patentee meant the reduction of all the materials to a fine powder, he was anticipated by Jensen, who had already expressed that in his patent. In my judgment, it is by these facts established that in 1890, pulverisation of the materials constituting the inner layers was not new, and that, whether the patentee meant complete or partial pulverisation. There is also evidence that during the partnership which existed between the two witnesses named Ford-Lloyd and Braun from 1886 to 1889, the materials for the inner layer were broken up with a pestle and mortar. All the above

materials are new to the present action. I think these defendants have established that pulverisation was in 1890 not new. I pass on to the second question, and here apply myself to ascertain whether in further anticipations and prior users, and further evidence of the state of knowledge in 1890, these defendants have shown that Hitchcock did not discover and disclose a new application of known principles in a particular and effective manner. Lord Justice Stirling found that Castle-Smith's arrangement closely approximates to that of the plaintiffs, and found a difference in the fact that the exciting agent—that is, the outer layer—was rather a semi-liquid than a semi-solid. This is the same ground as that of Lord Justice Vaughan-Williams. Lord Justice Cozens-Hardy felt great difficulty about Castle-Smith, but he also thought that the phlegmy substance G could not be called semi-solid or plastic. This again was the same ground. If they had found the outer layer in Castle-Smith to have been a semi-solid or plastic, I gather that they would have thought that that was an anticipation. The new anticipations which these defendants have adduced may be divided into two classes, first those of the sandwich type, of which Skrivanow and Germain may be taken as samples. They contain the sequence of the layers, the physical constitution of the ingredients, but not the construction which the plaintiffs adopt. The other class is the Leclanché class, and first particularly Brandon's. Brandon has a zinc pole, but it is a plate and not a cup, and it is therefore necessary to enclose his apparatus in a cup of some sort, and he takes a glass jar; in this there is no substantial difference. He takes a porous vessel, inserts a plate of carbon and fills the interstice between the carbon and the porous vessel with peroxide of manganese reduced to powder, or with a mixture of peroxide of manganese and powdered graphite. He fills the interstice between the porous vessel and the glass with sand or sawdust, or other granular substance which will, as he says, thicken the water, and in that material places the zinc. He then moistens the entire mass of sand and peroxide of manganese with a concentrated solution of hydrochlorate of ammonia. He intends, I think, to construct either a battery which will have, or one which will not have, free water; for while on the one hand he closes his jar and puts on an india-rubber cover with a cut in it, which serves as a vent that will intercept the liquid if the jar should be turned over, thus indicating a fluid cell: yet, on the other hand, he says at page 4, line 5, that if you desire to transport the cell you must take care that your liquid is absorbed into the sawdust or sand, thus indicating a dry cell. Assuming that the amount of liquid is reduced to such a point as that it is all absorbed, that, as it seems to me, is in every essential particular the battery which the plaintiffs make. In this state of things, I take the words of the Court of Appeal, and ask myself: What application of known principles in a particular and effective manner has Hitchcock indicated which is not indicated by Brandon? I cannot point to any. Mr. Salaman says there are the same elements, the same constructive idea, but not the same invention, if you regard this invention as a combination giving a new and useful result. I cannot agree that this is so. The limbs, he says, are old, the organism new. I think that, from the other evidence, particularly that of Mr. Swinburne, it results that not only the elements, the ingredients and the constructive idea are old, but that the organism, the combination is old, and is found in all essential particulars in Brandon. The next anticipation which these defendants put forward to which I will refer is Jensen, of 1885, one of Hellesen's improvements, that is an invention directed to the inner layer. So far as that layer is concerned, it seems to me to be an anticipation of any directions which Hitchcock gives as regards pulverisation. The second Hellesen patent, that of Castle-Smith, of 1889, deals further with the outer layer, the phlegmy substance, G. I cannot find in the plaintiffs' patent any new application of old principles in a particular and effective manner which differs from that pointed out by Brandon, Jensen, and Castle-Smith, explained as regards the last by the evidence in this case. The last I propose to mention upon this part of the case is Gassner. He has not two layers, it is true, but this only in the sense that the carbon pole and inner layer are in his battery replaced by an agglomerate pole of carbon and manganese. He has a zinc cup, and the space intervening between the cup and the agglomerate pole is filled by a mixture in all material respects the same as the plaintiffs' outer layer, except that the flour is omitted and oxide of zinc is found in its place. As regards Gassner's battery I have this to observe. Hitchcock tells me that the semi-solid which forms his inner layer is to be packed in and around the carbon. The plaintiffs have argued that this means that it is to be rammed. It has been proved before me that the E.C.C. cell, which is the successful cell, in fact, now manufactured by the plaintiffs' licensees, is made of pulverised manganese and carbon, merely wetted to such an extent as to prevent the dust from rising. This is put in, a small quantity at a time, into the battery and rammed down tight, by the use of a cylindrical rammer with a cylindrical hole to pass the carbon and beaten with a mallet. The plaintiffs say that the E.C.C. cells are not made by them but by their licensees, and that they are not responsible for this method of manufacturing, but they argue that such a packing is within their specification, and, if it be, I am entitled to compare a cell so made with the alleged anticipation of Gassner, and I have great difficulty in seeing what difference in substance there is between the agglomerate pole used by Gassner and a pole thus made by the plaintiffs' licensees. If Castle-Smith was so close as the Lords Justices held it to be to the invention which they have upheld, it seems to me that the anticipations which I have just dealt with are much closer, and that I am at liberty, and, in fact, bound, to use my own powers of reasoning to see whether after those anticipations have been called to the attention of the Court, there exists in Hitchcock's specification any new application of old principles in a particular and effective manner. Using the best of my judgment, I arrive at the conclusion on the facts now proved that there does not. But reliance was placed by the defendants upon a cell made with clay, according to Thiebaut. Thiebaut's papers were four in number. Three were before the Court of Appeal, the fourth was not. The Court of Appeal found that Thiebaut's first three papers were not an anticipation, the fourth only adds this, that if you take Thiebaut with all the knowledge of to-day, you may, consistently with what he says, make a good working cell; but Mr. Swinburne's evidence is that a successful cell was made by adding to Thiebaut's defective knowledge of chemistry, the knowledge of to-day, and that anyone, without regard to this case, taking up Thiebaut, and told to make a sample cell according to it would not produce the cell produced before me. The prior users which the defendants have set up are, first, Gassner—with which I have already dealt under the head of anticipation—and, secondly, cells made by Lloyd and Braun. The date of their manufacture is from 1886 to 1889, onwards. I have no doubt at all as to that; the evidence about it is plain, and if anything more were wanted, it is given by an agreement, dated September 29th, 1888, relating to certain machines which they sold, and for which they made batteries. Lloyd and Braun have described the method of manufacture. I see no reason to doubt that they manufactured as they say. It was consistent with the knowledge of the time. If their evidence is to be trusted, it is such as the plaintiffs' specification describes in all material respects, except that chloride of potash was sometimes added to the ingredients. The cell which Lloyd and Braun so made, or substantially that cell, became known before the year 1893 as the E.S. cell. In 1893 the plaintiffs threatened proceedings in respect of the manufacture, but in the result no proceedings were taken. Mr. Thompson obtained then—in 1893—one of the batteries of 1889, and gave evidence as to what was its condition in 1893. I think it a fair subject for comment on the part of the defendants that for 10 years—from 1893 to 1903—no proceedings were taken, and that in the interval Mr. Thompson had destroyed the specimen battery of 1889. If the case fell to be decided on this evidence, I should have analysed more closely evidence which I see no reason to doubt, but having regard to the view which I have formed on other parts of the case, I do not find it necessary to rest my judgment upon this prior user. The battery as made in 1892, and subsequently called the E.C.C., is made as described by the witness Piggins. The inner layer is not wetted beyond the addition of sufficient liquid to prevent the dust from rising, and is then put in and rammed tightly with a rammer and a mallet. It is the battery thus made that has met with success. Its efficiency depends on the pulverisation and the tight packing. Semi-solidity, or plasticity, in the sense of a damp plastic mass, as distinguished from a tightly rammed moist powder is not used, and is not so successful. The defendants are persons who manufacture a battery similar, I think, in all respects to the plaintiffs', with two significant differences. The first is in the outer layer; they do not employ plaster of paris and flour, but blotting paper, for the outer layer. There is no question but that the use of blotting paper is quite old. The second difference is that the inner layer is never, in any meaning that I can attach to the words, a plastic solid. The defendants' method of manufacture is described by a witness named Cousins, who was not cross-examined. To 25 lbs. of mixed manganese and carbon the defendants put ¾ of a pint of liquid. The result is a slightly damp powder. There is moisture enough to prevent the dust from rising—nothing more. This powder is put, by small instalments at a time, into a zinc cell, round which several folds of blotting paper have been placed, in the centre of which is a carbon rod. It is then hammered down with a rammer and a mallet. As regards the amount of the pulverisation of the mixed manganese and carbon, the evidence is that the defendants do not reduce the whole mass to a fine powder, but do reduce it to a mixed mass of such a nature that capillarity will result. The result at which I arrive from the foregoing considerations is that these defendants have established facts not established in the previous action, and that I am not bound to hold that the invention which the Court of Appeal found to have been made, was anticipated; and, further, whether that be so or not, the battery as constructed by the defendants is not constructed in infringement of the invention as found by the judgment of the Court of Appeal. Being of this opinion, I think the plaintiffs fail. I desire to add that throughout this case I have felt the greatest hesitation in relying upon my own powers of reasoning. I have read more than once, and have analysed the judgments in the Court of Appeal, in the desire to assimilate as closely as I can the views which they have expressed and with the intent to approach this case from their standpoint; but I am conscious that I may have but imperfectly succeeded. It may well be that from want of familiarity with this branch of the law, or from my own imperfect understanding, I am unconsciously not giving the full effect which I ought to give to the decision of the Court of Appeal. If this be so I deeply regret it; but at the same time, it is unquestionably my duty, taking that judgment as my starting point, to apply to the new facts before me the closest reasoning which I can bring to bear for the purpose of seeing whether the decision on this patent ought, as against these defendants, and upon the present facts, to be in their favour or against them. Discharging that duty to the best of my ability, I think that they have displaced the conclusion of fact upon which the Court of Appeal proceeded in the previous action, and being of that opinion I am bound to act upon it. The decision at which I arrive is really of little or no moment. My principal function has been to see that both parties have a fair opportunity of proving all the material facts, so that the matter may come upon proper materials before the Court of Appeal. This case was obviously, after the previous action, not defended, as it has been before me with the intent that it should not terminate in this Court if the plaintiffs succeeded, and I do not anticipate that it is any more likely to terminate here

because they fail. My judgment is for the defendants. I dismiss the action with costs.

Mr. Astbury: I suppose, after what your Lordship has said, if we do feel disposed to have another try, your Lordship will allow the costs?

Mr. Justice Buckley: I have regarded that as a foregone conclusion.

Mr. Astbury: It may be a question of ways and means will come in. Subject to that, your Lordship will allow the costs to be paid on the usual undertaking?

Mr. Justice Buckley: Yes.

Day *v.* the British Electric Tramways Co., Ltd.

In the Chancery Division on Tuesday before Mr. Justice Kekewich, Mr. Cane applied in this case for an order for the production of certain documents necessary in an action which the plaintiff was bringing to obtain rescission of a contract to take shares on the ground of misrepresentation in the prospectus of the company. Counsel explained that the company was in liquidation, and that Messrs. Lumley & Lumley, solicitors, had a lien upon the documents for costs. That lien had now been satisfied, and he asked that the documents should be handed over.

Mr. Ryland, for Messrs. Lumley & Lumley, said that as his client's lien had been satisfied they had no further interest in the documents, but certain costs had been incurred in connection with them, and, of course, they would require to be paid.

Mr. Justice Kekewich directed the documents to be handed over to the defendant company to be produced as required.

Electric Traction Co. *v.* Electric Tramways Construction and Maintenance Co.

Mr. Justice Swinfen Eady, in the Chancery Division on Friday, heard a motion to continue the appointment of a Receiver to the defendant company till trial of the action. No progress had been made in the action since the appointment of the Receiver a month ago in the hope that proposals for reconstruction would be agreed upon.

His Lordship declined to continue the appointment for more than a week.

Sellon *v.* "Daily News."

His Lordship in this action gave judgment in accordance with the verdict of the jury, and depriving plaintiff of costs, remarking that they had dealt liberally with the plaintiff, and that the action ought never to have been brought.

Dixon *v.* Ito Syndicate, Ltd.

This case came before the Master of the Rolls and Lord Justice Cozens-Hardy in the Court of Appeal on Saturday. The appeal was by defendants, who were sued as trustees for the London and Counties Electric Tramways Corporation, Ltd.

Mr. Rufus Isaacs, K.C., and Mr. Clavell Salter appeared for the appellants, and Mr. Pickford, K.C., and Mr. Llewelyn Davis for the the respondants.

Mr. Rufus Isaacs, K.C., said the appeal was from an order under Order XIV., made by Mr. Justice Walton at Chambers, who had varied an order made by the Master. The plaintiff, Mr. Dixon, claimed £7,401 under an engineer's certificate for work done under a contract and damages for wrongful determination of an agreement by the defendants. The Master, as a condition to defend the claim ordered the defendants to bring the £7,401 into Court. The Judge varied that order by directing that £6,660 should be brought in, and gave leave to defend the action as to the balance and as to the claim for damages. The present appeal was for unconditional leave to defend. The learned Counsel explained that Mr. Dixon entered an agreement with the defendant company, who had purchased from the West Riding Tramways and Electricity Supply Co. certain rights to construct tramways and erect electrical storage plant to carry out the obligations of the syndicate under an agreement of March 7th, 1902, for £220,000. Under this agreement he was to be paid at least half the contract price in cash and the balance at the option of the syndicate, either in cash or shares in the West Riding Co. The work, as it progressed, was to be passed by the engineer, and the plaintiff was only to be paid on his certificate. Subsequently a gentleman of the name of Schenk came upon the scene, and by an agreement between the parties Schenk was to pay Mr. Dixon, but if his engineer refused to give a certificate, or if from any other cause he did not pay, the plaintiff's former agreement was to hold good against the Ito Syndicate. All the work executed prior to November, 1902, was paid for. Then came the work for which the £7,401 was claimed. Mr. Schenk's engineer refused to pass it, alleging that it was not properly done, and therefore, although the other engineer had given his certificate, that gentleman declined to pay, and the plaintiff thereupon sued the syndicate. The learned Counsel submitted that the syndicate had a good defence to the claim, and further, that the facts and documents were too complicated for this to be a proper case to be tried under Order XIV. At any rate, unconditional leave to defend should be granted.

Mr. Pickford, K.C., supported the order appealed from.

At the close of the arguments,

The Master of the Rolls gave judgment. He said this was a a case which could not be properly tried under Order XIV., as it involved most difficult and delicate questions both of fact and law. The case must go for trial in the ordinary way, the defendants having unconditional leave to defend.

Lord Justice Cozens-Hardy concurred, and the appeal was allowed.

An Electricity Co.'s Truck.

At the City Summons Court an employé of the City and Charing Cross Electricity Supply Co. answered an adjourned summons for causing a truck to stand longer than necessary for loading or unloading. The case had been fully heard by Alderman Dr. Crosby, who had been asked to state a case for appeal, but his suggestion that the company, the Corporation and the Board of Trade should try and agree upon the hours during which the company's street work should be carried out, was agreed upon.

Mr. Vickary, who represented the Corporation, said hours were fixed under the Sewers Act, 1848, and the Corporation had asked the Board of Trade to approve of the same hours for the work of this company. It was still before the Board of Trade.

Sir Horatio Davies, M.P., decided to ignore the agreement, and stated he would hear the case and give his decision.

The truck and a tent stood obstructing traffic from 9 a.m. till 12.30 p.m. while men were at work on one of the company's test boxes, and while they had their dinner.

Mr. Vickary said the company defied the Corporation by setting up their Act, under which they did the work, but they might pitch half-a-dozen tents and any number of trucks and their men sit round fires having their meals, and they would say it was necessary. This was a growing public nuisance.

Mr. Frampton regretted having to go into the whole of the facts again, and was contending that the company did the work under statutory powers, when

Sir Horatio stopped him, commented upon the public inconvenience, and said he should impose a fine of 20s. and costs.

Mr. Frampton complained that he was still making his submissions.

Sir Horatio: You might take up weeks. I maintain you have committed an offence, and fine you 20s. and costs.

Mr. Frampton said he had witnesses to call.

Sir Horatio said he would consider the evidence heard, and the company could appeal.

Mr. Frampton gave notice of appeal.

The Reading of Meters.—Question as to the Right of Entry Without Notice.

At the Brompton County Court, on Monday, before Mr. Clement Lloyd, sitting as Deputy Judge, the Brompton and Kensington Electric Supply Co. applied for an injunction to enable them, by their inspectors, to enter the premises of Mr. and Mrs. Shadforth, 143, Gloucester Road, Kensington, W., for the purpose of reading the company's meter. Mr. E. Pugh, solicitor, appeared for the company, and Mr. Herbert Smith, counsel, for the defendants.

Plaintiffs' solicitor explained that the electric lighting companies were bound by Act of Parliament to supply electricity for lighting purposes to any persons residing in the district who sent in an application in the usual way. The Act, on the other hand, gave the companies certain facilities for conducting their business; and, among other things, it said, in Sec. 24 (Act of 1882), that any officer appointed by the undertakers might, at all reasonable times, enter any premises to which electricity was, or had been, supplied by the undertakers, in order to inspect the meter, &c. There was a contract dated November 4th, 1901, between the plaintiff company and Mrs. Shadforth for the supply of electricity to her house—she being the lessee—but on various occasions when the inspectors called to read the meters they were refused admission because they had not made an appointment. A letter upon which he (solicitor) would rely was from Mrs. Shadforth, and ran as follows:—"I am aware that your man was refused admittance to my house, and if he comes 50 times, unless an appointment is made beforehand, the same thing will occur. I shall never allow strange men to come into my house whenever they please." The plaintiff company had some 3,200 customers, and, in the usual way, the meter readers had to make their inspections within about a week or 10 days of quarter days. Four meter readers were engaged, each of whom had to read about 75 meters a day, and it was clear that the work of the company would be "absolutely dislocated" if they were expected to send a post card to each customer to make an appointment.

Some of the company's inspectors bore out solicitor's statement regarding the refusal on various occasions to allow them to read the meter at defendants' house. One of these inspectors said that he always had the company's card to show, but on his calling at the defendants' house the card was never asked for. Witness was not aware that the water companies generally issued notices intimating when their officers were going to call, and he did not know that the police had issued notices warning people against letting persons into their houses without proper evidence of their authority.

Mr. T. J. Owens, secretary to the plaintiff company, said that he had personally pointed out to Mrs. Shadforth how unreasonable it was to expect them to make an appointment for each call of the inspectors; and he had also drawn her attention to the Act of Parliament, giving them power to enter the houses at reasonable times for the purpose of reading the meters. The lady then flatly refused to allow one of the inspectors to enter and read the meter, and it was only after a deal of wrangling that she allowed the engineer, whom witness brought with him, to see the meter. The time for the inspectors to make their calls was between 9 o'clock a.m. and 4 o'clock p.m. In cross-examination, witness said that the mere

reading of the meter was a comparatively small matter; but it was most important that the officers of the company should be allowed to enter a house in case of an accident to the installation. Witness admitted that the defendants had supplied the company with post-cards, stamped and addressed, requesting that the day and time of the inspector's call might be given by this means.

The Judge: The question is whether it was reasonable or not for the officials to call to read the meter without first making an appointment?

Mrs. Shadforth stated that, having had several things stolen from her house, she gave instructions to her servants to let no workmen of any kind whatever enter the house unless they (the servants) were previously told who was coming and what the men were coming for. Her servants may have refused admission to the inspectors, but when she was at home and saw the inspectors they were never refused admission. On one occasion she asked the inspector whether he had any evidence to show that he came from the company, and he merely referred to the letters on his cap. Then she asked whether his black book would indicate that he was one of the company's officials, and he replied that he had only a private memorandum book. She had told the company's secretary the terms upon which she was prepared to continue the use of the electricity.

His Honour said that before he could grant the injunction he would have to be satisfied that the lady had acted, under the circumstances, unreasonably, but although she might have got angry, he came to the conclusion that she had done nothing to justify the granting of the injunction. There would be judgment for the defendants with costs.

PARLIAMENTARY.

Royal Commission on London Traffic.

Sir David Barbour presided on Friday over a further sitting of the Royal Commission on London Traffic.

Mr. Maurice FitzMaurice, the engineer to the London County Council, was called. He said that the breaking up of streets for laying and repairing pipes, &c., had become a most serious obstacle to locomotion in London. Owing to the general use of wood paving, the streets necessarily had to be broken up and re-laid at comparatively frequent intervals. Frequently several companies broke up the streets one after another, causing great inconvenience which could be avoided if there were some agreement between the companies, or if there were some controlling authority which insisted on the work by the different companies being done at the same time. The water, gas and other companies had at the present time statutory powers to break up the streets whenever they wished on giving notice. Under existing arrangements the company breaking up a street for any purpose generally re-laid the paving in a temporary way, and the local authority at a later date re-laid it permanently.

In reply to a member: No doubt it was advisable that the local authority should do the permanent laying of paving, but it must often be extremely difficult for them to keep the requisite staff to enable them to do the work, as the amount of the work varied so greatly. The Corporation of the City of London had promoted a Bill last year "to regulate and control the opening or breaking up of streets in the City by authorities, undertakers, and other persons having statutory or special powers in or over such streets." Witness was of opinion that power was required to deal with that question all over London. The first object to be aimed at was to prevent different companies opening the streets at different times. With a controlling authority it would be possible to regulate the work so that the minimum amount of inconvenience was suffered by the public. Witness submitted cross-sections of the Strand and streets in other parts of London showing the number of pipes, &c., in the streets. Dealing with the question of subways, he said that the London County Council, when making new streets, and in many cases of improvements in streets, constructed subways for gas, water mains, electric light and other cables. In London at the present time, there were, under the control of the Council, 14 subways, of an aggregate length of 5¼ miles, the length of the subways varying from about 100 yards, in the case of Garrick Street, to about 2,230 yards in the case of the Victoria Embankment. The subways contain gas pipes, water mains, telephone cables, both of the Post Office and the National Telephone Co., electric light cables, District Messenger wires, and the mains of the Hydraulic Power Co. The largest pipes in a subway were two 48-in. gas mains in the Commercial Road subway. The cost of subways varied with the size and the conditions under which they had to be constructed. A subway 12 ft. × 8 ft. would cost about £18 per yard run for construction. Several of the pipe subways built by the L.C.C. were already full, and in many cases it was very difficult to get at a leaky joint. One important point was that the subways should be made as close as possible to the cellars of the houses, so as to avoid driving side galleries for the house connections. Until the year 1893 the Council did not possess any special powers for the regulation of subways, but in that year the London County Council (Subways) Act was passed, under which the Council made bye-laws for the regulation of subways. The bye-laws included a scale of charges to companies and others using the subways. The Council had power to compel all companies or bodies laying new pipes in a street where there was a subway, to lay them in that subway, and it could, at its own cost, insist on old pipes in a street being relaid in a subway, if one were constructed. Under the bye-laws which were made and allowed by the Board of Trade in December, 1895, and which were still in effective existence, two scales of charges for users of subways were laid down, the first scale to be levied on companies having power to break up the streets, and that meant, broadly, the gas and water companies, but did not mean the London Hydraulic Power Co. The second scale was levied on the companies who had no statutory powers to break up the streets, such as the National Telephone Co. and the District Messenger Co. The London Hydraulic Power Co. paid under the latter scale for the older subways. The General Post Office, which occupied space for precisely the same purposes as the National Telephone Co. paid at the lower rate, but insisted on a special reduction. It paid the special scale, less 5 per cent. That was the only special case. The electric lighting companies were not under the Subways Act, but under the special provisions of the Electric Lighting Orders; they were, however, practically in the same position and paid at higher rate. In reply to further questions, witness said that he considered street markets were another great obstacle to locomotion. The erection of lamp posts along the centres of all except very wide roads was a serious obstacle also, as they made it difficult for the quick traffic to pass the slow traffic. Witness then described the various means of cross-river communication—bridges, tunnels and ferries. Questioned regarding suggested street improvements, witness mentioned one proposal, which was to construct a road from the Crystal Palace district to Waterloo Road near Waterloo Station, and from there to be continued across the river by means of a high-level bridge between Waterloo and Blackfriars Bridges. One branch of such a street might then fall to meet the eastern crescent of the new Holborn to Strand street, and another branch be continued with a bridge over Fleet Street between Chancery Lane and Fetter Lane. He gave rough estimates of the cost of such a street from the Strand southwards to the county boundary. He took three types of streets. Type "A" would be a street 150 ft. wide, consisting of footpaths of 20 ft. on each side; the central portion of the street, 30 ft. in width, reserved for motors and other quick traffic, and on each side of the central part a width of street of 40 ft. for surface tramways and slow traffic. Underneath would be a subway for single-decked tramcars, and there would be the usual pipe subways and sewers. The cost of this type worked out at £2,560,000 per mile. Type "B" was a street 100 ft. wide, with two footpaths each of 14 ft. and a roadway of 72 ft. Underneath would be a double subway for both quick and slow tram traffic and the usual pipe subways, &c. This type would cost about £2,400,800 per mile. The third type, "C," was the same as "A," so far as the surface was concerned, but instead of placing the tramcars in the shallow subway they would be carried in deep level tubes. This type was estimated to cost £2,740,000 per mile.

In reply to Sir John Wolfe Barry, Witness said that he did contend that such a road as that suggested from the Crystal Palace to the Strand was an immediate necessity. He had mentioned the scheme as it included a bridge over the river between Waterloo and Blackfriars. Continuing, witness said that the best way of dealing with cross streams of traffic was to carry one over the other, as had been done at Holborn Viaduct. He went on to describe what had been done, and was proposed to be done, with regard to the electrification of the tramways in London. The line to New Cross and Greenwich would be opened in October. Contracts for other portions had been let. The estimated extra cost per mile of double track incurred by using conduit system was about £13,000. The total cost, including equipment for the conduit system, was about £52,600 per mile. At the present time there was no tramway connection between North and South London. The Council had promoted a Bill this session to continue the tramway from the Holborn to Strand subway to the Embankment and over Westminster Bridge, but that part of the Bill had been struck out on instruction by the House of Commons Committee. He considered that a tramway over Southwark Bridge, which was very little used, would be a great advantage.

By Sir John Wolfe Barry: That was merely his opinion; he did not know if the bridge was strong enough to carry a tramway.

Witness then described how a shallow tramway might be constructed from Hammersmith Broadway *vid* Hammersmith Road, Kensington Road, Hyde Park, and Green Park to Walsingham House, Piccadilly, and from the last-named places to Charing Cross a tube. He said that there was no engineering difficulty in constructing a shallow subway under the Strand, or even under Piccadilly. A useful North and South connection could be made by continuing the tramway in Vauxhall Bridge Road to Edgware Road in a tube. Comparing London with New York, he said that the difficulty in London was to provide a paying scheme which would deal with both long and short-distance traffic. There was no such difficulty in New York. New York was a narrow city 13 miles long and about 1⅔ or 2 miles wide, so that one or two railways running the length of the city could carry passengers to almost every part of it. Witness concluded by referring to motor-car traffic. As soon as an omnibus which could be worked profitably was made, improvements in detail would soon follow.

The Commission then adjourned.

Chatham and District Light Railways.

The Select Committee of the House of Commons (Mr. T. G. Ashton, chairman) had the Chatham and District Light Railway and the Rochester Corporation's Tramway Bills before it on July 13th and following days.

Mr. Ram first opened the case for the Rochester Corporation. He said that the two Bills, though different, would have to be taken concurrently. The Corporation Bill had for its object the creation of certain tramways in Rochester, the purchase of land for a new street in connection with the tramway scheme and other

subsidiary matters. Tramways in Rochester had long been considered a necessity, but up to the present, difficulties had been experienced owing to the narrowness of some of the streets at various places. In the year 1897 the Chatham and District Light Railway Co. went before the Light Railway Commissioners and asked for power to make a light railway, which would, in effect, be a tramway, through Rochester and Strood. At first that was opposed by the Corporation, and afterwards concessions were made by the promoters, to the Corporation. The Corporation then approved of the scheme and supported it. However, when that scheme came before the Light Railway Commissioners, Rochester was struck out of the scheme, the Commissioners being of opinion that the streets were too narrow. The Commissioners passed the scheme with the exception of the lines in Rochester. The tramways, of which there were 8½ miles, were now working with great success. The object of the present application was to extend the tramways to Rochester. Since the tramways in Rochester were refused, £10,000 had been spent on widenings in that city; Rochester, Strood and Gillingham were practically one town. Chatham in the immediate vicinity was an immensely populous place, doing an immense amount of work. The industry in Rochester had largely extended, the steel works alone employing some 800 men. The Corporation had long known that tramways were a necessity for Rochester and Strood. There was only one difficulty, that was the narrowness of some of the streets, but a new street was proposed, and other widenings were now in progress. The tramways as proposed would cross the bridge and enter Strood. There were two "reliefs" proposed by the scheme, a double tramway in one place, and a "relief street" to take the heavy traffic. Continuing, counsel said that at the time that the Corporation were proposing their Bill, the Chatham and District Light Railways Co. were proposing a Bill to make certain extensions themselves; they were anxious to make some tramways inside the territory of the Corporation, besides other tramways. What was proposed would, he thought, save a great deal of litigation. The Corporation and the company said, "It is of no use having rival schemes, let the Corporation make everything in tramways confined within the actual boundary of the Corporation, and let the Chatham and District Tramway Co. make all the necessary parts of the scheme outside the boundary." That had been agreed to between them, and whereas the Corporation proposed to make certain other tramways, it was decided that one of the lines should be abandoned and the alternative route proposed by the company be adopted. At the time when the Corporation and the company agreed to have one good scheme, the Corporation were intending to run certain lines down towards Borstal. Now the proposal was that the Corporation should make the line to Delce and the company the line from Delce to Borstal. The amalgamation had been approved by Lord Morley. Another proposal, which had also met with Lord Morley's approval, was that the Corporation should construct the whole of the lines, both inside and outside the borough, and the company had agreed to take over the outside lines on lease, and pay the Corporation an amount for a term of years which should recoup the capital and interest of making them. The company were also prepared to give the Corporation a sum for widenings. There would be no risk to the ratepayers, who, with the exception of one or two ratepayers, were in favour of the scheme. The capital asked for was £140,557. The lease would be for 40 years, at the end of which time the Corporation would own their own tramways. Dealing with the opposition to the Bill, counsel said that the first petition was from the South-Eastern and Chatham Railway, on the ground of competition; but, he contended, there would be no competition with the railway. Counsel concluded by referring to the petition of certain frontagers on the routes of the proposed tramways.

Mr. Roskill then opened the case for the Chatham and District Light Railways Co. The company was incorporated under the Light Railways Act, 1896, and got a Light Railway Order in the year 1899, authorising 8½ miles of tramways. The lines they now proposed to construct was a line from a spot near Chatham, "Jezreel," to Rainham, 3½ miles in length. Then an extension to Maidstone 7 miles in length, and a further line from Strood to Gad's Hill, Charles Dickens's house. It was originally the intention of the company to carry a line as far as Gravesend, but it was dropped as the Corporation opposed. At the conclusion of counsel's speech,

Colonel Savage was called and examined by Mr. Balfour Browne, K.C. Witness was of opinion that the Rainham route would be an advantage as affording communication with Fort Darland.

Mr. Yates, of Chatham Dockyard, Mr. Richard G. Lock, and Mr. Apsley Kennette, town clerk of Rochester, and other witnesses then gave evidence in favour of the scheme.

On July 14th, Mr. Ernest Rotter, C.E., consulting engineer to the Rochester Corporation, said that he had prepared the estimate of the Corporation scheme. The cost would be £66,109. With regard to the narrow thoroughfares, he said that the cars would have to be carefully worked.

Mr. Thomas H. Minshall, C.E., said that there were no engineering difficulties in the way of the Rainham or Maidstone routes. The system would be the overhead trolley system.

Several local witnesses were then examined.

On July 15th the case for the South-Eastern and Chatham Railway Co. was opened by Mr. W. B. Clode calling and examining Mr. Ryde, a surveyor, as to the alleged unsuitability, on account of the narrowness of the proposed route through the City of Rochester and Strood.

Major-General Hutchinson, formerly of the Board of Trade, also gave evidence on this point. He said that there were several steep gradients and awkward junctions on the route. Cross-examined by Mr. Ram, witness said that he knew that the narrowest part of the route was 17 ft. in width. The steepest gradient was outside Strood, but he did not admit that the population was more sparse at that point, although there were perhaps fewer houses just there. Cross-examined by Mr. Balfour Browne: He did not know that "any number" of tramways had been sanctioned by Parliament in streets just as narrow as that. He did not know of the Exeter tramways, sanctioned earlier that session. He could not say how far those tramways were identical with the scheme now before the Committee.

Mr. Tempest, engineer-in-chief to the South-Eastern and Chatham Railway Co., said that he had been over the route along which it was proposed to have the trams. The route through Strood and Rochester was absolutely unsuitable, not only on account of the narrowness, but also because the road was bad. There were several gradients of 1 in 22 and 1 in 16. For a great part of the way there was not the statutory clearance. He submitted plans showing where the clearance was not up to the requirements of the statute, and photographs of the route. He instanced several accidents which had occurred on tramways having steep gradients. Every precaution was, no doubt, used; but the gradients were too steep. With regard to the line from Chatham to Maidstone, there was one very bad hill on the route. That line was in direct competition with his company's railway, and would, no doubt, be carried to Gravesend in time. There would be further competition with his line as the tramways proposed to carry goods. Their local traffic would also be affected. Cross-examined by Mr. Balfour Browne: The railway company objected to the tramways in the narrow streets because the company were large carriers, and the trams in the streets would greatly interfere with their carts and wagons. He had had no experience of the magnetic brake.

By Mr. Ram: In considering the narrowness of the route in Rochester he had taken into consideration the proposed relief street, but he did not think that that would greatly improve matters, for there were several public houses in the narrow street, and brewers' drays would have to draw up to deliver goods.

Mr. Ram: But do you know that there are bye-laws now in force prohibiting the delivery of barrels, &c, at public houses after 8 a.m.? That would remove the difficulty, would it not?—Witness was not aware of the existence of such bye-laws.

On July 16th, after hearing further evidence, the Committee found the preambles of both Bills proved, and the clauses were then adjusted.

Mr. Ashton, reporting to the House of Commons for the Committee considering this Bill, states that on the initiative of the Board of Trade a clause has been inserted which provides that for the purpose of calculating the fares, rates and charges, the tramways and tramroads proposed to be authorised should be deemed to be part of the undertaking authorised by the Chatham and District Light Railways Order, 1899. The Bill contains powers enabling the promoting company to borrow by instalments, but it having been proved that such powers would facilitate the raising of the capital, the Committee were of opinion that standing order 153 need not be enforced. It was further decided to allow the payment of interest out of capital on the additional capital proposed to be authorised. The Bill enables the Corporation of Maidstone in a certain event to exercise the powers sought to be conferred on the company in regard to the construction and working of tramway No. 3, which is situate in the Borough of Maidstone, and tramway No. 4 and a small portion of tramway No. 5 situate respectively in the adjoining rural parish of Boxley, or to acquire the said tramways. Such tramways will form one continuous line in and from the borough of Maidstone northward in the direction of Chatham. The Committee are of opinion that having regard to the special local circumstances, such powers ought to be allowed.

Birmingham Tramways.

Mr. Ashton's Select Committee of the House of Commons had the Bill which the City of Birmingham Tramways Co. are promoting before them on 16th and 17th inst. The Bill, said Mr. Fitzgerald, in opening the case for the promoters, was to authorise the extension of the existing Yardley tramways from Sparkhill to Otton, and from College Road to Shirley. Shirley was a village in the Solihull district, having a population of 1,500. The local authorities both at Yardley and Solihull were in favour of the scheme, and the only opposition was from the Great Western Railway Co., whose grounds were competition. The Warwickshire and Worcestershire County Councils were in favour of the Bill, and there was no objection of any sort from frontagers. The proposed tramways would be of great advantage in developing the districts they would serve. Mr. John Hughes, the chairman of the Yardley Rural District Council, was called, and said that the facilities given by the Great Western Railway Co. were not sufficient for the wants of the districts. Mr. F. L. Thompson, the clerk to the Councils of Yardley and Solihull, gave similar evidence. Mr. Nettlefold, the chairman of the Housing Committee of Birmingham Corporation, was also called with regard to the necessity for a cheap means of communication between the city and the surrounding districts.

On Friday, Mr. Stephen Sellon, the electrical engineer to the City of Birmingham Tramways Co., was the first witness. He said that 600,000 workmen were carried in and out of Birmingham every year by the existing tramways to Yardley. The overhead system would be used for the new tramways.

The Chairman asked Witness if it was intended to make the tramways at once, if sanctioned, as he saw that the Bill asked for five years in which to construct them. He thought that it was an unnecessarily long period, and Mr. Sellon said that the company intended to construct the tramways at once.

Mr. Power, traffic manager of the omnibus department of the Birmingham and Midland Tramways Co., having given evidence in support of the scheme, Mr. Moon addressed the Committee on

behalf of the Great Western Co. The Chairman said that the Committee found the preamble proved, and the Bill was ordered to proceed.

London County Council Tramways.

The London County Council (Tramways and Improvements) Bill came before Lord Harris's Select Committee of the House of Lords on 13th inst.

The case for the promoters was opened by Mr. Erskine Pollock, K.C., with whom appeared Mr. Moon, K.C., and Mr. Du Cane. Counsel said that with the exception of the two short lengths, the proposed tramways were all in the borough of Hammersmith. Tramway No. 3 was a double line nearly three miles in length, commencing at Scrubbs Lane, on the north side of Wormwood Scrubbs, at the county boundary, and terminating in Queen Street, near the junction of that street and Bridge Road. It would thus join the line authorised last year. Certain widenings would have to be carried out in connection with that route, and would have to be executed before the line was constructed. In connection with the proposed new line were two short lengths of tramways, single lines both of them, for the purpose of forming junctions with the existing line of the London United Tramways Co. Turning to tramway No. 4, counsel said that that line was a double line 2 furlongs 4 chains in length, and would begin at the Broadway, Hammersmith, a junction would be formed with tramway No. 3, and the line would terminate on the Middlesex side of Hammersmith Bridge. The other lines were in the parishes of Streatham and Wandsworth. Tramway No. 6, which would be a double line 1 furlong 6·20 chains in length, would begin at the south-western end of Wimbledon Road, and would come to a termination at Garratt Lane, where the line authorised in 1901 would be joined. Another short length of line was that proposed in route 6A. It would be a short double line from Wimbledon Road to Garratt Lane. It was proposed to construct the lines so that electrical power could be used. Certain sections of the Act of 1890 were incorporated in the Bill, so that tramway lines within the London area should be electrified under the same rules. Dealing with the cost of the proposed scheme, he said that lines Nos. 3, 3A and 3B would involve £68,000, and certain widenings which would be carried out in connection with those lines would mean an additional £64,300. The Hammersmith Borough Council would contribute one-third of the last-named sum. Tramways Nos. 4 and 4A would cost £15,500, and the other lines £8,300.

The London General Omnibus Co. and several owners and occupiers of property opposed the Bill, and various objections were raised by the Hammersmith Borough Council. Mr. Benn, the chairman of the Highways Committee of the London County Council, was then called, and gave evidence in support. Mr. Fitzmaurice, the engineer to the Council, and other witnesses were also called.

On 14th inst. Mr. J. H. Rider, electrical engineer to the County Council, was the first witness. He said that it was proposed to work tramway No. 3 on the overhead trolley system. That was the line which would run from Scrubbs Lane to the Broadway, Hammersmith. The line of the London United Tramways Co. would be crossed at two places, in the Goldhawk Road and the Uxbridge Road. Some mechanical provision would have to be made for carrying the overhead trolley wires of the Council's system across the company's wires. He explained that there were two methods of doing that. They could place insulated crossings at the spot where the lines actually crossed, or they could have "section insulators" some few feet away, so that the crossings could be electrically connected. He was in favour of the latter method.

Mr. Moon said that the petition of the tramways company alleged that there would be leakage, to which witness replied that experience had shown that there was no danger of that. Cross-examined by Mr. Balfour Browne, K.C. (for the London United Tramways Co.), Witness said that he did not know of any place where a system such as that proposed existed, and in reply to Mr. Moon, said that if the Committee had any doubts as to the system being satisfactory electrically, he would be quite willing that the Board of Trade should control the crossing arrangements.

Mr. Erskine Pollock announced that an agreement had been arrived at between the promoters and the Hammersmith Borough Council, by which the Council considered itself sufficiently protected. Their petition would, therefore, be withdrawn.

Counsel for the Hammersmith Borough Council said that three points had been in dispute. The widening of Wood Lane was the first, and a clause had been inserted with regard to that. Then a clause had been agreed upon to the following effect:—That the London County Council should submit to the Borough Council plans showing the position of all posts and wires, &c., which were to be placed in the borough. The last point was with regard to the widenings generally. His clients were satisfied with Mr. Benn's statement that the widenings would be carried out. It had always been felt that the lines would benefit the locality.

Lord Robert Cecil addressed the Committee on behalf of the frontagers. He said that the tramway from the Broadway to the end of the bridge would greatly inconvenience the traffic, as the thoroughfare at that point was narrow and crowded. Witnesses in support of that contention were called.

Mr. Ernest Pollock agreed to strike out the two junctions, 3A and 3B, with the system of the London United Co.

The Committee having conferred in private, the Chairman announced that they found the preamble proved as far as Tramway No. 3 was concerned, it being understood by the Committee that there was an undertaking on the part of the London County Council that the method of crossing the London United Tramways Co.'s lines should be such as met with the approval of the Board of Trade, all costs approved by the Board of Trade in relation to such crossings to be borne by the London County Council. Tramway No. 6 was passed, and also No. 4; but the Committee could not see the necessity of taking the line to the proposed terminus of No. 4. They were of opinion that the tramway should end at the broad part of the road, at a point a little south of Bridge Street.

The petition of the Westminster Corporation was then considered, Mr. Blennerhassett explaining that the Corporation claimed the right of one month's notice before the London County Council should open the streets for the purpose of laying cables in connection with the tramways; they also asked that plans should be submitted to the Corporation for approval.

On the 15th inst., at the conclusion of Mr. Blennerhassett's address, the Chairman said that the Committee found the preamble of the Bill proved. They could not give the clause asked for by the Corporation, but they thought that the Corporation should be satisfied with the undertaking which the promoters had given, that they would deposit plans of the works and give notice to the Corporation of what work they were going to carry out in the streets. That undertaking the Committee considered binding on the London County Council. The Chairman added that if Borough Councils generally were dissatisfied they should approach Parliament collectively, and endeavour to secure an alteration in the general law.

Sutton Coldfield Tramways.

On July 14th the Select Committee of the House of Commons, presided over by Mr. Hayward Johnstone, concluded their consideration of the Bill promoted by the Corporation of Sutton Coldfield, under which, amongst other things, they seek power to make certain tramways.

Mr. Wedderburn, K.C., who represented the promoters, said that the scheme now before the Committee differed from that which was considered by the House of Lords Committee in that it stopped at Mere Green instead of going on towards Lichfield. In order to meet the views of the County Council it had been agreed for the present to make only a single line in certain places, until suggested street widenings had been effected. The proposed tramways would connect up with the Erdington, Aston and Birmingham tramways, and would afford greatly increased facilities for passengers. The inhabitants generally were in favour of the scheme, and had expressed a decided opinion that if the tramways were allowed they should be in the hands of the Corporation.

Evidence in favour of the scheme was given by a large number of witnesses, including the borough surveyor, Mr. W. A. H. Clarry, who said that he had laid out the tramway in conjunction with Mr. Haltain, and it presented no engineering difficulties. The estimate for the scheme, including the cost of the generating station, was £71,550. The tramway would run practically parallel with the line of the London and North-Western Railway Co., but it would accommodate the public in quite a different way from the railway. They had an offer from the City of Birmingham Tramways Co. to work the tramways on a 21 years' lease, paying 6½ per cent. on the outlay for the first ten years, and 7½ per cent. for the remaining 11 years of the lease.

Alderman W. J. Seale, the chairman of the Electric Lighting Committee of the Corporation, said there was a great and pressing need for the proposed tramways, as the facilities offered by the railway company were totally insufficient to deal with the traffic. He considered that the additional accommodation could be best provided by means of tramways as proposed, coupling up with the Erdington tramways.

A great deal of evidence was tendered in opposition to the Bill by the London and North-Western Railway Co.

Sir Frederick Harrison, the general manager of the company, stated that the train service provided by his company was sufficient to cope not only with the present traffic, but they were also prepared for a considerable increase in the near future.

After hearing Sir Ralph Littler, K.C., in opposition to the Bill, the Committee announced that they had not found the preamble of the Bill proved so far as it related to the construction of the tramways.

Somerset and District Electric Power Bill.

On 15th and 16th inst. a Select Committee of the House of Commons, under the chairmanship of Sir A. Godson, considered the above Bill. Mr. Shiress Will, K.C., Mr. L. Macassey and Mr. Acrouth appeared for the promoters. The opponents were the Corporation of Bristol, represented by Mr. Freeman, K.C., Mr. Balfour Browne, K.C., and Mr. H. Gregory; the Bristol Waterworks Co., represented by the same counsel; and the West Gloucestershire Waterworks Co., represented by Mr. Ram, K.C.

Mr. Shiress Will, K.C., in opening the case for the promoters, said the proposed share capital was £750,000, with the usual borrowing powers of one-third, making a total of £1,000,000. The company was promoted by local men of position, and the area of supply included Bristol, Bath, Wells, Glastonbury, Trowbridge, Radstock and other towns. The Bath Corporation opposed the Bill in the House of Lords, but were not opposing it on the present occasion, and the great issue involved was as to whether Bristol ought to be excluded from the operation of the scheme. The Bristol Corporation had expended about half a million of money on their electric light undertaking, and had begun to supply power, and they wanted to exclude the company from the city. All the other local authorities concerned were in favour of the Bill. He contended that Bristol was amply protected by the clauses contained in the Bill, which laid it down that the company could only supply to authorised undertakers and to persons requiring a supply for power purposes. Further, the company could not supply energy

except to authorised undertakers or to any railway, tramway or water company in any area which formed part of the area of supply of any authorised distributors without the consent of those distributors, but if any authorised distributor refused consent unreasonably, then the company might appeal to the Board of Trade, who could dispense with such consent if they deemed it unreasonably refused or withheld. The consent was to be deemed to be unreasonably refused if the authorised distributors were not willing and in a position to give the requisite supply on reasonable terms and within a reasonable time, regard being had to the terms on which and the time within which the company were able and willing to give the supply. The opposition of the water companies was founded on their desire to compel the company to take their water for the scheme, but that would only mean the company throwing money away.

Prof. Capper, the joint engineer of the scheme, said that if the company were allowed to go within Bristol, Bristol would be one of their chief customers. No doubt they would be able to give a cheaper supply than the Corporation did. In the conditions that made for economy, Bristol would not compare with a large and varied area. The important thing was the load factor, and that became greater where there was a considerable area to supply than where there was a comparatively small one. In Bristol the power plant was entirely separate from the lighting plant, and consequently the full benefit in respect of the load factor was not obtained. With regard to the charges, he said that under the Bill the company could not receive more than 3d. At Bristol the maximum was 7d., and the average rate 3·44d. The power rate, however, was only 1·9d. He concluded that very little power was sold, and that the consumption was nearly all in lighting. He estimated that there would be somewhere about 1,500 users of power in the district. The generating station at Hanham would be the most important of the two stations, as it was near Bristol. The scheme would cost nearly a million, which would leave them about £65,000 capital to work with. The mains alone would cost £300,000, and there would be 300 miles of cable. Cross-examined: An alternating system could not be used for supplying power in the way the company would supply power. Should Bristol be taken out of the area of supply, he thought the company would still make the undertaking pay; but Bristol was essential to the scheme as it stood.

A large number of local witnesses were then called, including Mr. Earle, chief engineer to the Imperial Tobacco Co. The company employed 5,000 hands in Bristol. The company had got supply for one of their factories from their own plant, but they also took a supply from the Corporation.

On Thursday the Chairman said that the Committee did not think that the question of sufficiency or otherwise of the capital was in any way raised in the petition of the Corporation, so that the question of the financial success of the company could not properly be discussed. Mr. Battey, a mining engineer of Frome, spoke of the great advantage the scheme would be to the Somersetshire coalfield. Mr. A. H. Bennett, the director of the Kingswood Colliery Co., said that that company leased six collieries and employed about 2,000 men. It would be an advantage to have one source of supply only. The director of Messrs. Lysaght's, Ltd., Mr. G. Gill, said that the price they paid for energy was still too high for economical working. A number of other manufacturers gave similar evidence.

Mr. Freeman said that he would open the case for the Corporation by calling witnesses.

Mr. Alderman Pearson, chairman of the Corporation Electrical Undertaking Committee, detailed the arrangements made for the supply of power. He said that their prices were more favourable than those of other municipal undertakings, and had been steadily reduced from year to year.

Sir Wm. Preece, the consulting electrical engineer to the Corporation, considered that the city was sufficiently provided, and could produce electrical energy as cheaply as any company. A Corporation which did not need to make a profit could supply energy at a much lower rate than could be done by a private company.

Mr. Brough Taylor, the engineer to the Bristol Waterworks, gave evidence to the effect that the streets of the city were already crowded underground, and that the laying of any more cables would cause trouble and confusion.

Mr. Balfour Browne, K.C., then addressed the Committee on behalf of the Corporation. He said that the company might lower its rates to ½d., and once the consent of the Corporation was overruled by the Board of Trade the statutory position of the Corporation was gone.

Mr. Shiress Will, K.C., replying for the promoters, said that he did not believe that the Board of Trade would sanction a rate which would be unremunerative and would disturb a local authority in its duty. The promoters did not intend to give a preference in making bargains with customers.

After consultation, the Committee found the preamble of the Bill proved, but required that the Corporation should be protected against any cutting of prices and that the company should not come in and charge absurd prices. The Committee wished to have some official of the Board of Trade to give them information as to what should be the exact form of the clauses to carry out the views of the Committee.

Worthing Corporation Tramways.—The Deputy-Chairman, who presided over the Select Committee of the House of Commons which considered the above Bill and found the preamble proved, has reported that a communication from the Postmaster-General with respect to the powers sought by the Bill for the use of electrical power upon omnibuses and motor-cars, was laid before the Committee, and they amended the Bill so as to provide that proper precautions should be taken to prevent the energy so used from injuriously affecting telegraph lines. The time limit for the proposed tramways (seven years) was in excess of the period allowed by the Standing Orders, but the Committee were of opinion that such period might be allowed, inasmuch as the tramways are, to a great extent, dependent upon the street improvements to be authorised by the Bill. The Bill authorises the Corporation of Worthing to construct and maintain a tramway 3 fur. 4·24 chains in length, in the rural district of Steyning West, beyond the limits of the borough of Worthing, but in connection with the tramways proposed to be authorised by the Bill, and having regard to the special local circumstances, the Committee are of opinion that the construction and maintenance by the Corporation of the said tramway ought to be sanctioned.

Scottish Central Electric Power.—This Bill came before Earl Morley's Committee of the House of Lords on July 14th, and there being no opposition, was ordered to go for third reading.

Shropshire, Worcestershire, and East Derbyshire Electric Power Bill.—The Worcestershire County Council has deposited a petition asking to be heard in opposition to this Bill.

Nottinghamshire and Derbyshire Tramways Bill.—Reporting to the House of Commons on the above Bill, the Deputy-Chairman says that by the Bill it is proposed to authorise the payment of interest out of capital during the construction of the tramways and works, but it having been proved to the Committee that the power to pay such interest would greatly facilitate the raising of the capital, a considerable portion of which would be raised especially locally, and the Committee having found that the clause authorising such interest was subject to the restrictions contained in Standing Order 167, they recommend that the payment of such interest not exceeding 3 per cent. per annum as proposed by the Bill should be allowed.

Bournemouth Corporation Tramways Bill.—Reporting to the House of Commons on behalf of the Select Committee which considered this Bill, the Deputy-chairman states that the Bill transfers to the Corporation the powers of the Christchurch and Bournemouth Tramways Act for the construction of tramways partly outside the borough, but in connection with tramways already belonging to the Corporation, the length of the tramway outside the borough being three miles odd. The Corporation is already empowered by the Act to run over and use the tramways outside the borough, and the Committee are of opinion that, having regard to the local circumstances, the transfer of the powers for the construction thereof ought to be sanctioned.

Woolwich Borough Council Bill.—This Bill, which seeks to authorise the Woolwich Borough Council to supply electrical energy in bulk to the District Council of Foot's Cray, on July 14th came, as an unopposed measure, before Lord Morley's Committee of the House of Lords, and the preamble was declared proved.

Watford and Edgeware Railway Bill.—The Committee of the House of Lords, presided over by Lord Morley, had this Bill before it on July 14th, and there being no opposition the preamble was declared proved.

Great Northern, Piccadilly and Brompton Railway (Various Powers).—On Thursday last week Lord Morley's Committee of the House of Lords considered the above Bill, which gives the company power to raise £250,000 additional capital and to take additional lands. It confirms the agreement entered into with the Metropolitan District Railway Co. and the Traction Co. The Bill was ordered to be reported for third reading.

London United Tramways Bill.—This Bill came before Lord Morley's Committee on Thursday last week. It seeks to confer further powers on the London United Tramways Co., Ltd., for the alteration and widening of roads in the parishes of Twickenham, Teddington, Hampton, Heston, Sunbury, Hanworth, East Molesey, New Malden, Mortlake, Wimbledon, Merton, Mitcham and Hammersmith, at an estimated cost of £80,172. The Bill was ordered to proceed.

Mid-Yorkshire Tramways.—This Bill incorporates the Mid-Yorkshire Tramways Co., and empowers that company to make about 18 miles of tramways in the West Riding of Yorkshire at an estimated cost of £143,487. It came on Friday before the Deputy-Chairman's Committee of the House of Commons, and was ordered to be reported to the House for third reading.

Chard Corporation Gas and Electricity.—The above Bill, which enables the Chard Corporation to supply gas and electricity in the borough, and to supply electricity in bulk to outside authorities, on Friday came before the Unopposed Committee of the House of Commons, and was ordered to be reported for third reading.

Dewsbury, Batley and Birstal Tramways.—This Bill authorises the construction of a new tramway in Ravensthorpe and the electrical equipment and reconstruction of the tramways in the Boroughs of Dewsbury and Batley and a number of urban districts. On Friday it came before the Deputy-Chairman's Committee of the House of Commons, and the preamble of the Bill was found proved.

Taff Vale Railway.—This Bill, which, amongst other things, gives the company power to work the railway by electric power, came on Friday as an unopposed measure before the Deputy-Chairman's Committee of the House of Commons, and was ordered to be reported for third reading.

Rochester Corporation Tramways.—Reporting to the House of Commons from the Committee which found the preamble of this Bill proved, Mr. Ashton says the Bill authorises the construction of new tramways, and certain of the tramways are to be constructed in streets to be made, widened or improved under the Bill, and the time for the construction of such tramways is limited to two years for the completion of the street works. This may extend the time for the construction of such tramways beyond the time limited by

the Standing Orders, but the Committee, under the circumstances, decided to allow the said period of two years for the completion of the street works.

North Metropolitan Electric Power Supply Bill.—Petitions against this Bill have been deposited in the Private Bill Office of the House of Lords by owners and ratepayers of Willesden and the Metropolitan Electric Supply Co.

Gosport, Fareham and Cosham Tramways.—This Bill came before the Deputy-Chairman of Committee of the House of Commons on Tuesday, and there being no opposition, it was ordered to be reported to the House for third reading. It has already passed the House of Lords.

Hove, Worthing and District Tramways.—On Tuesday this Bill was before the Select Committee of the House of Commons, presided over by the Deputy-Chairman, and in the absence of opposition, the preamble was found proved.

South-Eastern, and London, Chatham and Dover Railways.—Authority is given in this Bill to enable the Joint Committee to work the railway by electrical power. On Tuesday the preamble was found proved by the Deputy-Chairman of Committee of the House of Commons, and it was ordered to be reported to the House for third reading.

CORRESPONDENCE.

Protection or Free Trade?

Although this question is one which inevitably becomes a party one, and is also one which cannot very well be discussed purely on its merits in regard to its beneficial or detrimental effects on the nation at large, personal interests and class privileges are large factors in the problems. Call it what we may—Fair Trade, Preferential Trade, Retaliation, or something introduced for the benefit of the Colonies or the Empire—it has the one fundamentally objectionable feature, and that is, it ends in benefiting one or more classes in this country at the expense of all the others. Hence we find every different class of trader clamoring for the privilege of being the fortunate protected class.

Protect me, is the selfish cry. The old sturdy, independent British spirit and enterprise has given place to the abjectly foreign whine for protection. And what has scared these weak-kneed traders so badly, that they are so frantically shouting for help, and explaining how money spent upon buying foreign goods is lost to everybody at home? As if the fact that *we get the goods did not balance* the money spent, was admitted. They complain of foreigners placing heavy imposts to keep out our manufactured goods from their markets. That is complaint No. 1.

Complaint No. 2 is that the foreigner can send in his goods free to compete with us in the home markets. Complaint No. 3 is that the foreigner is competing alongside of us in Foreign and Colonial markets with more and more effect. This is all too true, but the adverse effects on our National (or Imperial) commerce are frightfully exaggerated by partisans, for other reasons than the good of the Empire and its commerce.

Retaliation is the only weapon to meet the first trouble, if that trouble can be shown to be so serious as to require such drastic treatment. It might even be adopted, in spite of the ugly fact that some class at home would benefit, while all the others would suffer as much as the foreigner!

A heavy impost on manufactured goods would affect the second complaint to the great benefit of the home manufacturers of the protected goods, but only if they were necessaries of life; if not, then the high price and restricted market would reduce the demand for them.

No. 3 complaint is a sure sign of supine weakness, and is incurable. If we cannot compete on common ground with foreigners, and beat them, then we are not worth protecting.

In the leading article on this discussion, it was suggested that Protection would meet with some considerable degree of support, not upon its merits as a pure question of the country's good, but on an interested basis it would be backed up by many.

That, to the writer, seems the most dangerous aspect of the question. There is also the fact that the question has not been raised upon a clean issue; along with it there is the bribe of higher wages and old age pensions. Protection could not stand alone upon its merits before the people whose earnings are largely spent on food. That fact its promoters seem to have realised at the outset.

For these reasons Protection seems to have a dangerously near chance of adoption. On its side are that numerous class who, to put it vulgarly, are "on the make"; whether the Protection is good for the country or not is to them of no account; it will be good for them, and that is enough. They will vote solid for it. Numbers will be gulled by the "higher wages" and "old age pension" makeweights. Others, again, will be scared by the Protectionist tale of woe and ruin through which the poor benighted country is passing, as proved by the immense trade we did in the seventies and the trade we now do, without explaining that the Continent of Europe was paralysed with war in '71 and '72, and the whole world was left to us to supply manufactures from our shops alone, without competition, during these years.

Then there is the man in the street, who knows practically nothing about the question. He may be about equally divided for and against; and, finally, the partisans, and those who cast in their influence with the proposers of a scheme in whom they have blind faith. Put them all together there is a large support for Protection on anything but rational grounds, and without considering its far-reaching results.

There is no comparison between Great Britain and any other country which can be fairly made on this question. The land in no case could produce a tithe of the raw materials and food we require, much less can it do so as long as the landowner is the heaviest burden on the land; we are absolutely dependent upon imports to support the mass of the population. Our industrial system has grown up under Free Trade far beyond the growth of any other country's industries, simply because it is the only system under which we can obtain the large bulk of imports required in a country whose land resources are very limited. Apart from food and raw material, which we must have from abroad, most of these imports are machinery and goods which are not made anywhere in Britain, or, if made, are antiquated and not as cheap or good, so that it is a positive benefit to the whole country that we should be able to get them, of the best in the world without paying a tax upon them.

Those most closely connected with commerce, and who are not influenced by the "On the make" principle, most readily admit that the damage to British interests actually due to foreign protection is grossly exaggerated for the purpose of securing the advantages of protection to the few at the expense of the many. It is futile to point to some declining industries unless that decline can be clearly brought home to Free Trade. Some industries are bound to decline in any country, whether Free Trade or Protectionist. At any rate, the question is always open for discussion, whether if a special trade cannot flourish alone and unaided it should be bolstered up by the community, or allowed to die a natural death?

We ought, on the whole, to be very thankful that our friends in the Western Continent are Protectionists. Just fancy, what with their population, their natural resources, vast land tracts and energy, would be the nature of their competition in the world's markets if they had Free Trade. Protection keeps up their cost of production of manufactured goods to such a height that they prefer to come to a Free Trade country to manufacture for markets outside of their own tariff walls.

That all business men are not panic stricken at the foreigner's conduct of his business may be shown by two references, first from the *Yorkshire Post* of July 17th:—

> In a speech yesterday the Mayor of Bradford said we had at home, at our own doors, sufficient trade to find employment for every citizen in the country. It used to be said that grass would grow in the streets of Bradford if they lost the American trade. They had lost that trade, but the grass had not yet begun to grow, showing that there was life in the old dog yet. Personally, he did not fear any competition. He thought Bradford could hold its own against all competitors. "And," Alderman Wade said, "I have very great hopes of the future, notwithstanding all the Protectionist ideas which are prevalent at the present time." A few years ago he thought France and Germany could beat us, but now he thought we could beat both of them put together.

The other reference is to the speech of the chairman of the E.C. Co. at the annual meeting reported on page 111 of last week's Electrical Review, declaring that he had no fear of German competition.

It is to men with these manly, fearless, and level-headed views that our trade and expansion of commerce is due; not to the self-seekers or scared supporters of weak trades.

The fairy tale about the money spent on a foreign product being lost to everybody at home, as is solemnly retailed in the *Electrical Times*, in order to scare its juvenile readers into being good Protectionists, may be referred to as a good example of the other attitude of hopeless panic and helplessness. Free Traders and Britons should deplore this humiliating exhibition, because it represents an incorrect view of our actual strength, even if there is some truth in the belief that we in some cases cannot compete under Free Trade. Too much fuss over magnified grievances, some of them manufactured, is the weakness of Protectionists.

A Fearless Free Trader.

Protection or Fair Trade?

Like all good citizens of the electrical persuasion, I have been much interested in the articles and correspondence on the tariff question in the electrical journals. Referring to your communicated article in the current issue, I still think Mr. Wilson has the best of the argument in spite of his strong language. Taking the case of the printer and his motors given by your contributor, I would ask whether it is better for the nation as a whole that Mr. Printer should spend £170 on goods manufactured in this country or should send £100 abroad, and *perhaps* spend the remaining £70 in trading with his own countrymen?

E. P. Allam.

London, E.C., *July 21st*, 1903.

Electricity in Mines.

In the issue of the Electrical Review dated July 3rd, Mr. A. B. Croft states his opinion that "The cables are, perhaps, to be considered as the most vulnerable portion of the system. Their improvement, in a mechanical sense, should, I think, pave the way for higher pressures." It will be of interest to your readers to hear something about this matter's standing on the Continent.

There, one has abandoned the above-mentioned idea long since, and is very busy introducing high tension electric power in mine work, it having been proved that, though the initial cost of installation may be rather high, the amount of money saved in the long run is very considerable, owing to the small losses of power in the cables as compared with those created by the escaping and condensing of the steam in the piping and by the quantity of firing material used in an old-fashioned plant.

High tension cable installations, with tensions up to 3,000 volts, have ceased to be looked at as risky undertakings, and have become an everyday occurrence on the Continent.

There have been certainly many difficulties to be overcome in the construction of cables and accessories for these purposes, and in the special method of laying and connecting them; but all these difficulties have, however, been satisfactorily disposed of, and the construction of cables for up to 12,000 volts for mine work will shortly come within the range of practical electrical engineering.

I would draw your attention to the fact that the Land and Sea Cable Works, Ltd., Nippes-Cologne, had a complete installation of cables and accessories for pits exhibited at the last year's Dusseldorf Exhibition, and were rewarded with the Exhibition medal "for pioneer work in the manufacture of high-tension cables and remarkably well constructed cables for pits and mines"; furthermore, with the "Silver States Medal for Industrial Achievements," the highest rewards for electric cables exclusively.

I shall be pleased to give any special information wanted to those whom it concerns on application.

The Land and Sea Cable Works, Ltd., Nippes-Cologne.
London Office: H. G. v. Ketelhodt, *Manager*.

27, Mincing Lane, London, E.C.

Iron Piping or Wood Casing?

In your report of Mr. de Segundo's paper read at the "International Fire Prevention Congress," you say "Mr. Broadbent disagreed with the suggestion to use iron conduits, which he thought led to greater possibility of fire than ordinary wood casing." What I said in the very hurried discussion which took place, was, that in my experience, more trouble was caused with iron piping than casing; and I am decidedly of opinion that without effective supervision there is more risk attached to piping work. If properly carried out, which it rarely is, I have no rooted objection to wiring in piping.

Frank Broadbent.

4, Queen Street Place, E.C.

Wiring Specifications.

The writer has read the several letters with reference to the objectionable clauses in wiring specifications; he has had several disagreeable incidents in connection with the discounts on fittings, and his firm never takes a contract unless sure of getting this discount. I have lately seen several architects in the town on the subject, who inform me that they are specially requested by the British Association of Architects to put in the clause that the contractor is to include for wiring, packing, fixing, and any trade profit on prime cost sums for the electric fittings, which may be purchased elsewhere. This, in my opinion, is not fair to the contractors, as it allows men with no establishment charges to do the work for no profit at all on this particular item. By this, I mean men who are practically working foremen on their own jobs, of which there are a considerable number in this town. This is a very hard subject to settle, and I think it could be dealt with best by the Associations of Contractors and Manufacturers conferring with the Association of British Architects.

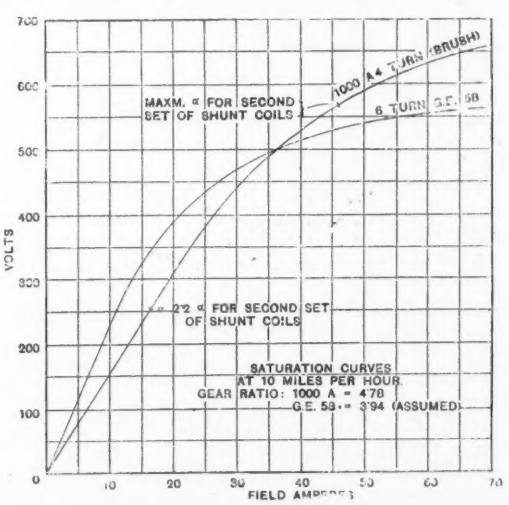
R. E. Dixon.

Leeds, *July 20th*, 1903.

REGENERATIVE TRAMCAR CONTROL.

The following additional details relating to the new system adopted by the British Electric Traction Co. for the Devonport tramways will be of interest to our readers:—

The car with which the demonstration described in our last issue was carried out is a four-wheel double-deck car, weighing about 9 tons, and carrying about 46 passengers; it is equipped with two Brush motors, type 1,000A. The line has a total length of about five miles; as will be seen by means of the profile diagram given opposite, the gradients


VOLTS
FIELD AMPERES
MAXM. % FOR SECOND SET OF SHUNT COILS
1000 A4 TURN (BRUSH)
6 TURN G.E. 58
2·2 % FOR SECOND SET OF SHUNT COILS
SATURATION CURVES
AT 10 MILES PER HOUR
GEAR RATIO: 1000 A = 4·78
G.E. 58 = 3·94 (ASSUMED)

Magnetisation Curves.

are very severe, the maximum being 1 in 10, and the total length of approximately level line does not exceed ¼ mile. The cars are provided with hand, slipper and rheostatic brakes, but in spite of these appliances, two cars have run away, with serious results; it was largely in order to obviate the risk of similar accidents that the new system was devised.

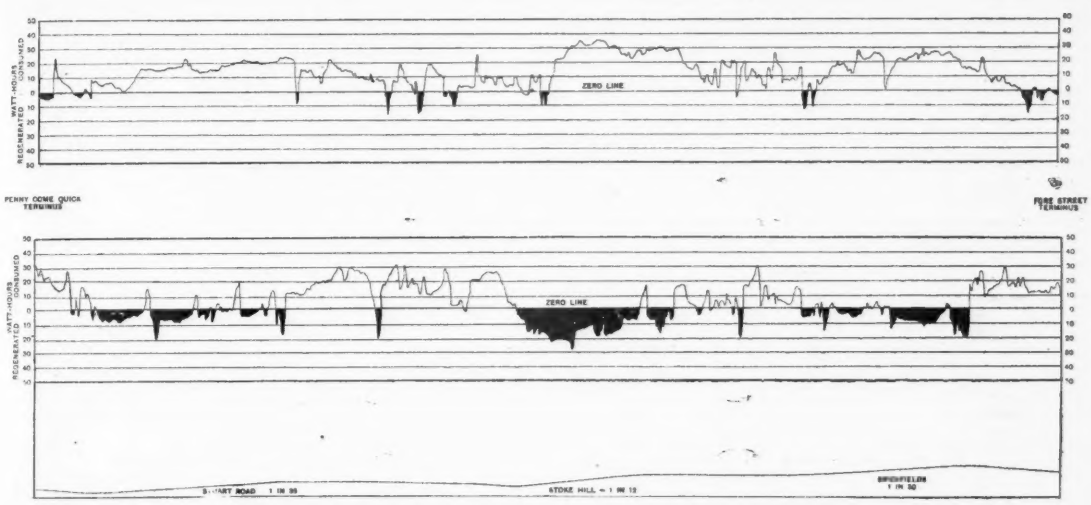
The alterations necessitated in the electrical equipment are as follows:—The field windings have been changed from series to compound; the motion of the power handle of the controller has been limited to the series notches; a speed

control lever has been added, interlocked with the power lever; an automatic switch has been introduced into the emergency circuit to cut out resistances when the line current fails.

No change has been made in the armatures or their connections.

The power is applied by means of the power handle as heretofore, but more quickly; this gives the car a speed of $2\frac{1}{2}$ to 3 miles per hour. The speed lever is then slowly moved forward for acceleration up to 14 miles per hour. Regeneration takes place automatically on a descending grade, or is brought about at will by pulling back the speed lever quickly.

In descending a grade of 1 in 12, the speed lever can hold the car steadily at $2\frac{1}{2}$ to 3 miles an hour. In the extreme backward position the speed lever releases the power handle, which instantly flies to the emergency stop and pulls the car up without any shock to 1 mile an hour.



Diagrams of Energy Consumed and Returned, and Profile of Route.

The effect is exactly the same whether the trolley be on or off the line, and the effect of shutting off the current in climbing a hill is that the car drifts slowly backwards at the rate of 1 mile an hour.

The net saving in energy, obtained over a large number of trial runs, appears to be about 30 per cent., as measured on the car, and the maximum demand on the line is reduced from 140 to 80 amperes per car. In descending hills the regenerative effect is usually 40 amperes (27 H.P.), sometimes, though seldom, rising to 50 amperes (33 H.P.) There is no heating or sparking of the motors beyond the normal. The brakes are superfluous except to fix the car on a grade, and the regenerative control is much quicker and more certain in braking than any of the brakes with which the cars are now fitted.

The effect of the modifications is graphically shown by the diagram of energy input and returned to the line, given herewith; the unshaded area above the zero line represents the former, and the areas shaded black show the energy returned to the trolley wire in traversing the route in both directions. It will be seen that the bulk of the saving is made in descending the long and steep inclines, but an appreciable amount is also gained by the use of the motors for stopping the car. The effect of the new winding upon the magnetisation curve of the motor is shown in the adjoining figure; it appears that a variation of field strength from a maximum of 100 to a minimum of 45, or 55 per cent., is obtained by the use of the shunt winding, giving the necessary range of speed and E.M.F. to fulfil the required conditions.

Commutator Grinder.—We understand that in the new power stations of the Manchester Corporation, which have recently been described in our pages, the commutator grinder made by the Phillips Machine Syndicate, Ltd., of 794, Salisbury House, London Wall, E.C., is used for truing and cleaning commutators.

BUSINESS NOTES.

"Hiko."—One of the most common causes of trouble with commutators and brushes is imperfect lubrication. One preventive method which has been used has been to boil the carbons in a lubricant. This, although a great improvement over dry brushes, was found to soften them, especially certain makes, and there was as a result too much non-conducting grease between the rubbing surfaces; as soon as the commutator commenced to heat more lubricant was given out, making worse contact and further increasing the heat. A brush impregnated with a fat or oil is not the best means to lubricate the commutator, for it cannot be regulated or controlled. Another method adopted in many power houses and with motors is to rub a lump of paraffin wax on the commutator while running. This sometimes stops sparking for a short time, but it has a nasty habit of getting between the sections and carrying a black conducting mixture of carbon dust with it. What is needed is the application of something which will make the face of the commutator so clean that the brushes make the best contact possible. A compound of this kind is on the market, and has been known to many of the large firms for the past three years; it is sold under the registered trade mark "Hiko," and is supplied in tin boxes. It is stated that if this composition be applied with pressure while the commutator is revolving it will remove an astonishing amount of black dirt; after several applications the commutator will acquire a nicely polished surface, and the rubbing-face of the brush will be burnished like ebony and have a hard face looking like glass. It has taken up enough "hiko" to lubricate it without softening it at all, and will resist wear very well. In actual practice a certain 90-B.H.P. motor running night and day, making 780 to 800 revolutions, fitted with 48 small carbon brushes, used up one set of these brushes every week, partly because the commutator—a large one—required sand-papering repeatedly. We are informed that the use of "hiko" stopped sparking, and for nine months not one new brush had to be put into the motor brush-holders. A great saving was effected in brushes alone. It is said that so much less heat is generated when "hiko" is used that in most cases a larger output can be got out of the machine. "Hiko" acts equally well with copper brushes. Formerly it was put up in cases like shaving sticks, but it was found that attendants rubbed the stick on the commutator, which took off 100 times more than was required. It is now put up in tins which can be carried in the waistcoat pocket, and sold by Mr. Hickley, of Southampton. We understand that it is also on sale in both America and Germany.

Annual Holidays.—The works of the Electric and Ordnance Accessories Co., Ltd., at Aston, will be closed from August 1st to 6th for the holidays, and goods cannot be received between those dates. The company's annual outing took place on Saturday, 18th inst., by train to Worcester. After a visit to the Cathedral there, the journey to Holte Fleet was accomplished by special steamer. The party numbered about 300, and all departments of the works were well represented. Unfortunately, the sports had to be postponed owing to the rain; they are to be held on the ground of the Stellite Cricket Club on Saturday next. From the same cause the majority of the party returned to Worcester by an earlier steamer than had been anticipated, and spent the evening seeing the sights in the "Faithful City."

The Langdon-Davies Motor Co., Ltd., closes its works from August 1st to 8th, inclusive, for the annual holidays.

Messrs. Willans & Robinson's works at Rugby, will be closed from August 1st to 10th.

Railway Signalling.—The Great Western Railway Co. it going to instal the British Miller electric automatic signalling system through the Severn Tunnel.

Electrical Wares Exported.

WEEK ENDING JULY 22ND, 1902.		WEEK ENDING JULY 21ST, 1903.	
Alexandria	Value £49	Alexandria	Value £199
,, Teleg. mat. ..	556	Amsterdam	125
Amsterdam	123	Antwerp	341
Auckland	1,298	Bombay	112
Bangkok	15	Boulogne	13
Bombay	27	Brisbane	100
,, Teleg. mat.	306	Buenos Ayres	3,165
Calcutta	184	,, Teleg. mat. ..	332
Channel Islands	40	,, Teleph. cable ..	175
Colombo. Teleg. mat.	105	Calcutta	1,118
Copenhagen. Elec. cable ..	1,081	Cape Town	600
,, Teleg. wire ..	99	Colombo	153
Durban	710	Copenhagen. Elec. cable ..	1,097
Flushing	11	Demerara	30
Ghent	10	Durban	1,479
Gibraltar	23	East London	375
Hamburg	51	Fremantle	245
Hong Kong	739	Gibraltar	27
Larache	16	Halifax	62
Lyttleton	37	Hamburg	17
Melbourne	924	Hong Kong	25
Moji	71	Lisbon	18
Nagasaki	500	Madras	151
New York	560	Melbourne	374
Otago	70	Penang. Teleg. mat.	99
Perth	108	Perth	80
Port Elizabeth	171	Port Elizabeth	380
Rangoon	102	Rio Janeiro	38
Riga	68	,, Teleg. appar. ..	2,852
Rio de Janeiro	135	Rosario	46
St. Petersburg	220	Singapore. Teleg. mat. ..	406
Singapore	24	Valparaiso	50
Sydney	1,071	Wellington	1,691
Tokio	20	Yokohama	600
Vancouver. Teleg. cable	813,000		
Wellington	531		
Yokohama	254		
Yokosaka	659		
Total ..	£823,963	Total ..	£16,515

Electrical Exhibits at the Agricultural Hall.—The annual Ironmongery and Electrical Trades Exhibition is now proceeding at the Agricultural Hall, Islington, and will remain open until 28th. As usual, the electrical exhibits form only a minor section, and there is nothing out of the way striking among them. There is a distinctly good collection of incandescent electric lamps and fittings, also the "Maxim" patent arc lamp, and the Kingsway electric street lantern attachment for gas lanterns, shown by the Sir Hiram Maxim Electrical and Engineering Co. Messrs. James Hinks & Son, Ltd., have some very impressive and artistic designs of electroliers, pendants, and so on, distributed among a finely arranged showing of oil and gas fittings. The Reed's Electrical Engineering and Supply Co., of Southwark Street, S.E., show the Edison-Reed incandescent lamps, electric fans, motors, &c.; lighting and bell fittings are exhibited at the stand of Messrs. Cardwell, Boorman, Ford-Lloyd, Ltd.; Messrs. Hopper & Co. show "Eureka" cycle lamps, E.R.G. dry batteries and other specialities; electrical slabs for switchboards are placed on view by Messrs. Sessions and Sons, Ltd., of Gloucester; Kynoch's, Ltd., of Witton, have their oil and gas engines for electric lighting, also roller bearings. The "Simplex" steel conduits and fittings are, of course, shown by the Simplex Steel Conduit Co., who are always well to the fore at such exhibitions. The British Prometheus Co., Ltd., who are showing some enterprise with their electric heating and cooking apparatus, are effectively and ably represented, and we learnt on the occasion of our call that their tramcar heaters have lately been tried in some electric cars in the provinces running direct on a 560-volt circuit, and have given excellent results. The American Electrical Novelty Manufacturing Co., Ltd., have a large collection of well-finished "Ever Ready" portable electric specialities. Incandescent lamps, bells, accessories, Strickland's patent "Reeplen" dry cell, and numerous other details are exhibited by the Davis Electric Lamp Co. The best collection of motors, indeed the only one of any consequence, is to be found at the stand of Messrs. F. A. Glover & Co., Ltd., where a number of from ½ to 5 H.P., and perhaps higher, are shown, also fans and many other things needed for a modern installation in large buildings. If we add to the above the name of Messrs. Rylands, Ltd., whose wires for many purposes, including telegraphic and telephonic service, are shown, we think we have exhausted the whole of the matters of electrical interest.

The Horsfall Destructor.—The makers of this destructor have received from the Sanitary Institute, in connection with their Health Exhibition at Bradford, now proceeding, the Institute's silver medal—the highest and only award given for destructors—for one of their patent "Portable" refuse destructors exhibited in operation. This is the third occasion on which the Horsfall system has been awarded a silver medal at the Sanitary Institute. The Horsfall Destructor Co. has recently obtained contracts for the Corporations of Leigh (Lancashire), Folkestone, Swansea, Stourbridge, Bridport, Gosport, Bloemfontein and Durban.

For Sale.—On Tuesday next, July 28th, Messrs. Percy Huddleston & Co. will sell by auction under the liquidation of Messrs. Hodges & Todd, Ltd., the stock and plant of an electrical instrument manufacturer, including lathes, drilling, sawing, milling and other machines, measuring instruments, &c., some particulars of which are given in our advertisement pages.

On July 31st Messrs. Green & Son will offer for sale by auction, the freehold riverside premises of the Sturtevant Engineering Co., Ltd., in Bankside, S.E. The Sturtevant Co. are removing to larger premises. See our advertisement pages.

Messrs. Wheatley Kirk, Price & Co. are offering for sale certain modern electric lighting plant. See advertisement pages.

Catalogues and Lists.—MESSRS. VERITYS, LTD., have issued a new circular, No. 54, containing a description of their open type "Aston" arc lamps. The testimonials are accompanied by street and interior views, showing the lamps in use. The parts of, and accessories for, lamps are also well illustrated and detailed in a series of tables, code words and prices being stated in every case.

The question of using electric omnibuses by which special tracks, essential with tramways, are avoided, has been to the fore recently, and no doubt will be more prominently under notice in the future. A neatly-illustrated *brochure*, which has been issued by MESSRS. SIEMENS BROS. & CO., LTD., describing the Siemens & Halske system, therefore comes very appropriately at the present time. Some of the illustrations shown have already appeared in the ELECTRICAL REVIEW (February 6th, 1903).

Brush Bulletin No. 3 is another of the excellent publications issued by the BRUSH ELECTRICAL ENGINEERING CO. It gives a description of their single trucks, maximum traction trucks, equal-wheel bogie and four-wheel bogie trail trucks, heavy service motor and trail trucks. Among the excellent pictures with which the text is accompanied, is a view of part of the truck shop at Falcon Works, Loughborough. A list is given of between 50 and 60 tramway and railway authorities who have placed truck orders with the company.

The BRITISH THOMSON HOUSTON CO., LTD., has issued another list for addition to its now bulky collection. It is numbered 146, and details sewing-machine motors. Prices of alternating and continuous-current outfits are given.

MESSRS. MATHER & PLATT, LTD., have brought out a new catalogue, in which their polyphase motors of several classes of design, also starting switches, are described and priced. The illustrations are executed in very fine style. Details of dimensions are stated.

Trade Announcements.—From Messrs. H. V. Kramer and Co., of Lower Weston, Bath, we have received a copy of their latest pamphlet, dealing with ball bearings and their application to direct-current generators and motors. Among the pictures shown is a dock-crane equipment, and a slow-speed steam-turbine-driven generator (10 H.P., 3,000 revolutions), both with ball bearings. After two years' work at the Karlsruhe manufactories, it is stated that ball-bearing machines have been made a practical success. Messrs. Kramer have formed a company, known as the Bath Electric Manufacturing Co., with a capital of £15,000, to manufacture electric crane and lift controllers according to a new system; also electric drills, Grisson gear motors, and other specialities. The company will work quite independently of the firm of H. V. Kramer & Co.

The publication offices of our American contemporary *Electro-Chemical Industry* are now located at 114, Liberty Street, New York.

Messrs. W. T. Glover & Co., Ltd., of Trafford Park, have taken extensive offices at Parliament Mansions, Victoria Street, S.W., for the accommodation of the directors representing the company in London.

Messrs. Ed. van Nierop & Co., merchants in Kobe, Yokohama and Moji (Japan), have recently started an engineering department which has been placed under the management of Mr. André Schmidt, mechanical and electrical engineer, for many years connected with several European concerns. The department will design and construct complete power and lighting plants, factory and mining installations.

M. Andre A. Godin, of 9, Little James Street, Gray's Inn Road, W.C., has been appointed sole English representative for the ignition and traction accumulators made by M. A. Dinin, of Paris.

We understand that Mr. Archibald Campbell, of Lonsdale Chambers, 27, Chancery Lane, W.C., has been appointed sole British agent for the Swiss Incandescent Co.

Mr. Harry W. Calderbank, of 78, King Street, Manchester, has purchased the whole of the stock and patterns of Messrs. Clayton and Co., Union Works, Huddersfield, who are retiring from business. Mr. Calderbank will continue the manufacture of the Clayton specialities.

Oil Separators.—We understand that Messrs. Baker's Patent Appliances Co., Ltd., of Scarborough, who are the sole makers of the Baker oil separators for exhaust steam, have now in course of construction the following separators:—For the York Electric Station, per Messrs. Dick, Kerr & Co., Ltd.; the University of Birmingham; Messrs. Hick, Hargreaves & Co., Bolton, direct; the Metropolitan Electric Supply Co., Ltd., five separators for their five Westinghouse engines of 2,500 H.P. each, direct; Wakefield Corporation Electricity Works, direct; Aberdeen Town Council Electricity Works, direct; Bristol Corporation Electricity Works; West Australian Government, per British Westinghouse Co.; Gibraltar Electricity Works, per Messrs. Belliss & Morcom, Ltd.; Wigan Coal and Iron Co., Ltd., direct; Tynemouth Corporation, direct.

Large Private Plant.—An installation which has recently been carried out by the National Electric Wiring Co., Ltd. (Dublin), at Messrs. Geary & Co.'s Confectionery Works, Limerick, is interesting in that producer gas is used as the source of motive power. The producer is of the Duff type, of 100 H.P., and there are two National gas engines, each driving a B.T.H. 30-KW. dynamo. The main switchboard consists of three panels carried by an iron frame, there being two generator panels, and a distributing panel carrying 12 change-over switches, fuses, &c. The lighting is effected by means of 240 glow and four arc lamps, and the machinery is driven by three 10-H.P., and two 5-H.P. B.T.H. motors, bolted to the ceilings. B.T.H. starting rheostats, with automatic no-volt and overload release, are provided. The plant has given great satisfaction throughout, and the cost of generation is found to be very low.

Livett v. South London Electric Supply Corporation.—The defendants were summoned before Mr. Hopkins at Lambeth last week to answer the complaint of Captain C. J. Livett, of Loughborough Road, Brixton, that they, being liable and required to supply electric energy to his residence, did unlawfully discontinue such supply, and had since made default in supplying such energy, and had thereby incurred penalties to the amount of £222, pursuant to the provisions of the Electric Lighting Orders Confirmation (No. 6) Act, 1892.

Mr. Matthews, addressing the Court for the defence, said the whole question in this case was whether or not the company were justified in cutting off the complainant's supply. The light in this case was supplied under a contract dated August 17th, 1901, by which the company undertook to instal a free installation of six 16-c.p. lamps. The meter rent depended upon the number of lamps that were used. Captain Livett had admitted that in addition to the company's installation he installed nine 8-c.p. lamps, the result of which was to make him liable for a meter rent of 3s. instead of 2s. per quarter. Captain Livett over and over again contended that he only owed 2s., and not 3s. The matter was allowed to go on for five quarters, and not being able to obtain the additional 5s. then due, the company in March cut off the supply.

After some discussion, a consultation took place between counsel, and Mr. Matthews afterwards announced that a settlement had been arrived at by which the company had agreed to make some compensation to Captain Livett, to pay his costs, and, without charge, reconnect his premises.

The summons was then withdrawn.

Edgewise Ammeters and Voltmeters.—Messrs. Everett, Edgcumbe & Co. are introducing small edgewise instruments, two forms of which we illustrate. A scale 4½ in. long is obtained, that is to say, of the same length as the ordinary instruments, seven or eight inches in diameter, whereas the actual space occupied is only 6⅝ in. × 3⅛ in. The actual saving in space is really greater than these figures would seem to indicate, owing to the fact that from their convenient shape they simplify the setting out of a switchboard, as they can be fitted in between switches, &c., or can be placed horizontally along the top of the board. The meters are supplied in two distinct forms:—Either for mounting on the surface of the switchboard (fig. 1), or for letting into it (flush type,

Fig. 1.

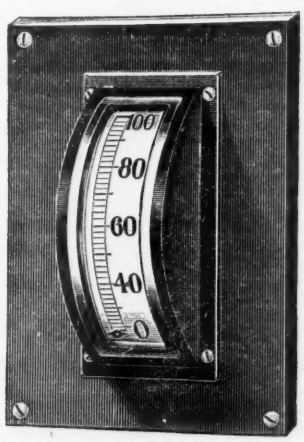


Fig. 2.

see fig. 2). Each type can be supplied with either horizontal or vertical scale, as preferred. Messrs. Everett, Edgcumbe & Co. supply these instruments either of the dead-beat moving-coil type, or of their moving-iron type. The latter are fitted with their well-known "air-damping" arrangement, whereby, without any friction whatever, that absolute dead-beatness is obtained which is so essential for motor work. The introduction of such compact and workmanlike meters ought to enable everyone installing an electric motor to add an ammeter, to act not only as a check on the efficiency of the motor and the plant which it is driving, but also as a valuable warning of anything going wrong.

High-frequency Currents and Cancer.—The possibility of curing cancer by means of electric currents of great frequency and high potential is still in an experimental stage, but the outlook is hopeful. On the authority of a medical man and an electrician, both of whom are said to be distinguished practitioners in this special aspect of treating disease, an article written by Miss Kathleen Schlesinger will appear in the August number of the *World's Work*. The article is illustrated by original photographs of patients under treatment.

Imports of Foreign Electrical Apparatus and Machinery.—The value of the foreign electrical goods and apparatus into this country during last month is officially returned at £60,434, as contrasted with £67,582 in May last, and £71,709 in June, 1902. During the same month the imports of foreign electrical machinery reached a total of £52,497, as compared with £37,466 in May last. For the first half of the current year foreign electrical machinery imported attained a value of £213,002, and electrical goods and apparatus £360,914, the latter comparing with £355,411 in the first six months of 1902.

Dissolutions.—Messrs. W. R. Laidlaw and G. H. Scholes (Laidlaw, Scholes & Co., electrical engineers and contractors, Manchester) have dissolved partnership. Mr. Scholes will continue the business as G. H. Scholes & Co., and he will attend to debts of the late firm.

Messrs. W. C. C. Hawtayne and F. Fairley (carrying on business as W. C. C. Hawtayne, consulting electrical and mechanical engineer at 9, Queen Street Place, E.C.) have dissolved partnership. Mr. Hawtayne will attend to debts.

New "Ediswan" Accessories.—The Edison and Swan United Electric Light Co., Ltd., are introducing a capital tumbler switch called the Ediswan H.V. "Wedge" type. The handle is rigidly attached to a block of porcelain carrying a transverse brass bar, which bridges between two copper springs, giving a double break. A spring throw-off is provided, and as in the act of switching off the porcelain block is interposed between the contacts, a perfect break is ensured. This is certainly a switch which for simplicity and efficiency, we think, can hardly be excelled. The company has also brought out a new double-pole key holder, in which the part attached to the handle consists wholly of porcelain; the parts are completely enclosed in two porcelain blocks, and the whole is thoroughly substantial and well finished. It is impossible to get a shock from either of these devices, which are perfectly suitable for pressures up to 300 volts. The "Economic" fuse-board is another new high-voltage fitting; the fuses, 3½ in. long, are carried in neat porcelain bridges, with clip connections, and the porcelain slabs for + and — poles are separate, and enclosed in a neat wooden case.

ELECTRIC LIGHT AND POWER NOTES

Barnstaple.—The L.G.B. has granted the T.C. the balance of the £4,400 loan needed for the purpose of extending the E.L. mains outside the compulsory area.

Berlin.—The Berlin Electric Company has produced and supplied, during the past year, 102,500,000 units, 6,000,000 more than in the previous year. The main portion of this enormous output was used by the electric tramways, which took 41,000,000 units. Industrial concerns come next, with a little under 25,000,000 units. Private establishments took 13,750,000 units, mostly for lighting purposes. For public lighting purposes, including railway stations, 1,700,000 units were used. Electric power to the amount of 20,000 H.P. was used by the tramway companies.

Bexhill-on-Sea.—The report on the U.D.C.'s electric light undertaking shows that last year a gross profit of £1,106 was made, but the balance against the Council is £2,337. There was an increase in the consumption of 61,670 units, and in the revenue of £950.

Bilston.—The Midland Electric Corporation has offered to supply energy to the public buildings at a reduced rate of 2d. per unit for seven years, subject to the right of the Council to call upon the company to carry out the public lighting of the streets being waived for five years. The Council is to be recommended to agree to this.

Bognor.—Subject to the security being satisfactory, the U.D.C. has adopted the electric lighting scheme submitted by Messrs. J. & S. Enright on behalf of Messrs. Suter & Co.

Bo'ness.—The T.C. has completed an agreement with the National Electric Wiring Co. for supplying and fitting up all the necessary plant for electric light and power supply within the burgh. The Council will provide the capital required, and pay the company a premium of 7 per cent. on the cost, while the company pays interest and sinking fund on the Council's loan at 6 per cent. The lease is for 20 years, with breaks at 10, 14 and 17 years. At the end of any of these periods the Council may bring the agreement to a termination, and if the company has made a greater average profit than 3 per cent. per annum during these years, the excess has to be paid to the Council, which takes over the works without further payment. The maximum prices are to be 5½d. per unit for lighting, 3d. and 2d. for power and heating, and 2½d. for streets and public buildings.

Bridgend.—A difference has arisen between the D.C. and the Electric Power Distribution Co. The latter, it is complained, has been negotiating with private consumers for the supply of light on the same terms as that supplied to the Council, and it is submitted by the clerk that it was distinctly stipulated that no light would be supplied to private consumers. Mr. Hill, the company's manager, has informed the Council that all disputes must be the subject of arbitration.

Bradford. — The Corporation has decided that the minimum charge for a stand-by supply of electricity shall be £7 per KW. installed, the KW. being reckoned at the maximum possible.

The new scale of charges fixed by the Corporation is as follows: —For private lighting, 4d. per unit, discount 2½ per cent., and an allowance of free lamps; for motive power to private consumers using 600 units or over, per horse-power installed per half year, 1¼d. per unit; 450 to 600, 1½d.; 350 to 450, 1¾d.; 250 to 350, 1¾d.; below 250, 2d.

The Corporation has adopted the revised general rules of the Institution of Electrical Engineers for the regulation of wiring.

Carthagena.—Vice-Consul Gray reports that a large electric works, which was in course of construction at the time of his last report, got into working order in May, 1902, and has since been supplying a large proportion of light in Carthagena, and exclusively in the surrounding villages, even invading the important mining centre, La Union, about 9 miles away. The works are also supplying power to work the mines, one or two of which have adopted electricity instead of steam. On account of the competition between the two electrical companies now catering for the supply of electricity to Carthagena and district, the price for light has dropped considerably, and the present electric light rates, though still high, are knocking out petroleum—which is very dear—to a very great extent.

Colwyn Bay.—The U.D.C. has decided to reduce the price of electricity to consumers of over 10,000 units per annum to 4½d. per unit. Energy for motive power on the new promenade works was offered at 2½d. per unit, with a minimum consumption of 80,000 per annum.

Edmonton.—The U.D.C. had before it on Monday a letter from Messrs. Frank Suter & Co. offering to enter into negotiations for the erection and running of an electric light system on the following or somewhat similar lines:—(1) The firm to submit detailed tender, with plans, specifications, and drawings; (2) the Council to borrow the necessary capital and pay the firm for carrying out the installation; (3) the firm to lease a suitable site from the Council for the erection of a station at a rent to be agreed upon; (4) the firm to repay the Council the cost of obtaining the prov. order and consulting engineer's fees for drawing up the specifications; (5) the firm to work the electric light installation on behalf of the Council, and provide a continuous supply of electricity for public and private lighting and power; (6) and to receive the entire revenue, in consideration of which it would pay the Council annually the interest and sinking fund charges, any profits earned beyond that to be divided between it and the Council; (7) the Council might as an alternative to the last clause collect the revenue, retain an amount equal to the interest and sinking fund charges and pay the maintenance and running expenses, any surplus to be divided, and any loss on a year's working to be made good by the firm; (8) any loss incurred during any year of working to be debited against the profit of any subsequent years; (9) the Council to have the option of taking over the undertaking without any payment at the end of each financial year by giving 12 months' notice in writing. The letter contained several other conditions, and was referred to the Electric Lighting Committee. It was stated that the North Middlesex Electric Supply Co. had been asked to state the terms on which it would work the order.

Felixstowe.—The U.D.C. has adopted a report from the consulting engineer, Mr. Wilson, recommending a total outlay of £17,160 for the purchase of the undertaking of the Suffolk Electricity Supply Co. and extensions thereto.

Halifax.—The accounts of the electricity works for the year ending March 31st last show that £4,972 12s. 2d. is transferred to the renewal fund, against which there are charges on the year amounting to £2,144 10s. 5d. That fund, including balance from the previous year, is now £7,095 6s. 5d. The expenditure on capital account during the year was £13,591, bringing the net total to £212,578.

Harrogate.—The T.C. has received from the L.G.B. sanction to borrow £46,000 for electric lighting purposes.

Hyderabad.—Messrs. Dick, Kerr & Co. have applied through their agents, Messrs. Roughton & Byron, of Bombay, for the sanction of the Nizam's Government to the introduction of electric lighting to the municipalities of Hyderabad and Chudderghat.

Johnstone.—The Clyde Valley Electric Co. proposes to supply electricity to the burgh for lighting purposes.

Liverpool.—On Wednesday last week one of the electric mains under the pathway outside St. John's Fishmarket fused, and became ignited. The fire brigade immediately commenced digging so as to get at the cables, and when this had been accomplished flames shot high up into the air, sending out volumes of black smoke. Endeavours were made to smother the flames, but without avail, and even the chemical engine when turned on had little effect. To add to the danger and difficulty, the heat of the fire attacked the gas mains. These gave way, and the gas in turn became ignited, sending out sheets of flame. The fire at this time had the appearance of a volcano in miniature, white hot cinders being flung into the air, and making it necessary for the brigade to stand a considerable distance from the footpath. During the operations of the brigade the fire also broke out in several other parts of the thoroughfare, the flames bursting through the flagstones. Eventually the electric cable was reached and severed, resulting in the fire being speedily extinguished.

London.—L.C.C.—At the meeting on Tuesday the County Council decided to sanction the borrowing by the Fulham B.C. of £31,874 for electric lighting works, and £352 for meters. An expenditure of £148,500 by the Highways Committee was sanctioned for the purchase of machinery, boilers, switchgear, and other plant for the power station to be erected at Greenwich.

Alteration of Pressure at Chelsea.—The Highways Committee reported that the Chelsea Electric Supply Co. had applied for the Council's consent, required by the B. of T. regulations for ensuring a proper supply of energy in the area scheduled to the Chelsea Electric Lighting Orders, 1886, to an alteration of the standard pressure of supply in that portion of the area south and west of an imaginary line passing through Marlborough Road, Coulson Street, Anderson Street, King's Road, Franklin's Row, Royal Hospital Road, and Pimlico Road to the eastern boundary of the company's area of supply. A standard pressure of 100 volts between the middle wire and either of the outer conductors had hitherto been used by the company, and it was now desired to increase it to 200 volts, with 400 volts between the outers. The company had given public notice of its application to the Council, and the Highways Committee had taken into consideration letters received from the company's customers, including the Chelsea Borough Council, in consequence of the notice. The Committee had been advised by the chief engineer on the subject of the application, and as a result the County Council decided to give consent, subject to conditions, including the following:—

That when an installation in any consumer's premises is to be changed to the higher pressure, the undertakers shall themselves carry out, or bear the cost of, any alterations which may be necessary in the wiring or the fittings of such premises.

That new lamps shall be arranged in series where so desired by the consumer.

That all the consumers' lamps in use and in stock shall be replaced by the undertaker, free of charge, with new lamps suitable for the higher pressure.

That the undertakers shall make good, at their own expense, any defects which may develop in any installation within three months of the date when the pressure is changed or the alteration completed (whichever may be the later date), where such defect can reasonably be attributed to the increase of pressure.

That a reduction of not less than 14 per cent. shall be made in the price of supply.

Disputes are to be referred to arbitration.

CAMBERWELL.—Last week the M.B.C. decided to purchase, at an estimated cost of £500, a 21-H.P. engine and dynamo for the electric lighting of the Camberwell Baths. A motion that the Supply of Electricity Bill be opposed was adopted.

HAMPSTEAD.—The B.C. on Thursday last week decided, upon the recommendation of the factory inspector, to enlarge 21 street transformer stations at an estimated cost of £1,080.

POPLAR.—The Lighting Committee of the M.B.C. has adopted the code of general wiring rules prepared by the Institution of Electrical Engineers.

BERMONDSEY.—On Tuesday the Lighting Committee reported to the B.C. that it approved of the suggestion in the following letter from the chief engineer of the L.C.C., and had directed the electrical engineer to carry out the same:—"The attention of a Committee of the Council has been drawn to the desirability of taking all possible precautions to prevent the access of gas into street boxes. In the case of some electric lighting street boxes it has been found advantageous to lay the cables through a small box before actually entering the street box (this might be placed in the thickness of the street box), and after the cables are led through it is then filled up solid with some impervious material, covered up and the work completed. This would undoubtedly in some cases increase the trouble involved in laying mains, but the great importance of the object to be gained seems to justify some extra cost." It was decided to fit the electrically converted gas standards at the corner of streets and at cross-roads with three and four 16-C P. lamps respectively, the annual cost in the first case being fixed at £5 10s., and £6 10s. for the four lamps.

STEPNEY.—The accounts of the electric light undertaking, issued recently, show the total capital expenditure up to March 31st, 1903, to be £153,291. The gross revenue last year was £19,626, as against £11,223 in the preceding twelve months; while the expenditure for the periods named were, respectively, £10,126 and £6,012. For the twelve months ending March 31st, 1903, there was a surplus of £5,145, of which it is intended to devote £2,833 to writing off capital expenditure, to place £1,000 to a reserve fund to pay off instalments of capital expenditure, and £603 to a second reserve fund for depreciation. In connection with the first reserve fund, it is pointed out that with many of the loans the repayments of capital do not commence until three years after the money has been borrowed. Attention is drawn, in the report, to the fact that the average price paid per unit for the public lighting is 1·6d. whereas the actual cost of generating is 1·82d per unit. The total revenue from private consumers, at an average of 2·75d. per unit, was last year £15,126, and the total revenue from public lighting, at an average of 1·6d. per unit, was £2,923.

CITY.—Last week an explosion occurred in Stonecutter Street, E.C. A workman with his pickaxe fractured one of the gaspipes lying just below the surface, and at the same time struck an electric lighting cable; the spark from this fired the escaping gas, and a violent explosion resulted. The man was thrown to the ground, but, with the exception of a few bruises, he escaped unhurt. Before the firemen arrived the flames had been extinguished.

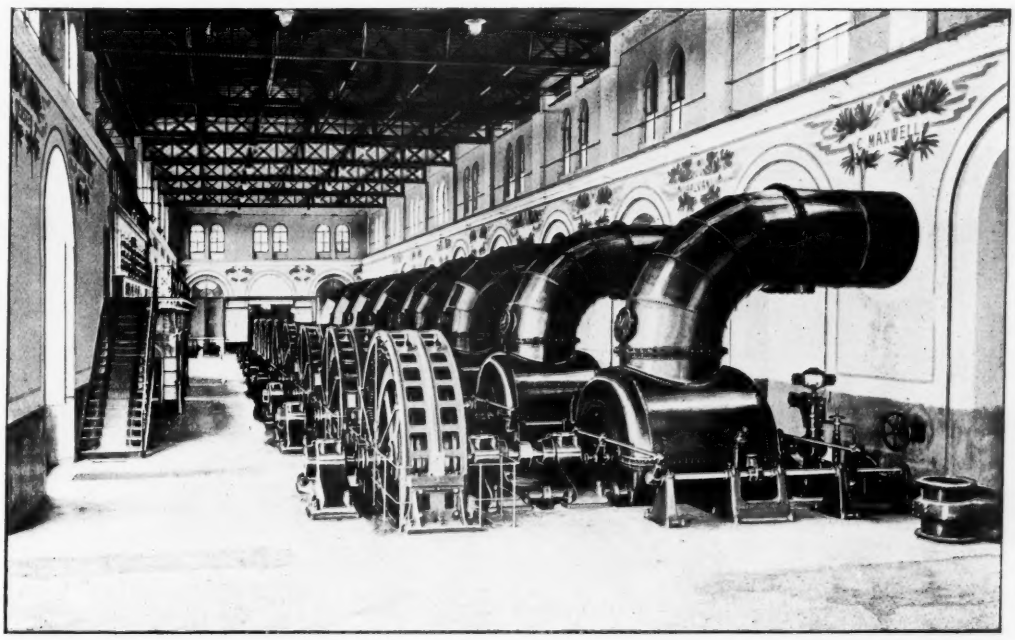
(*Continued on page* 147.)

HYDRO-ELECTRIC POWER STATIONS IN ITALY.

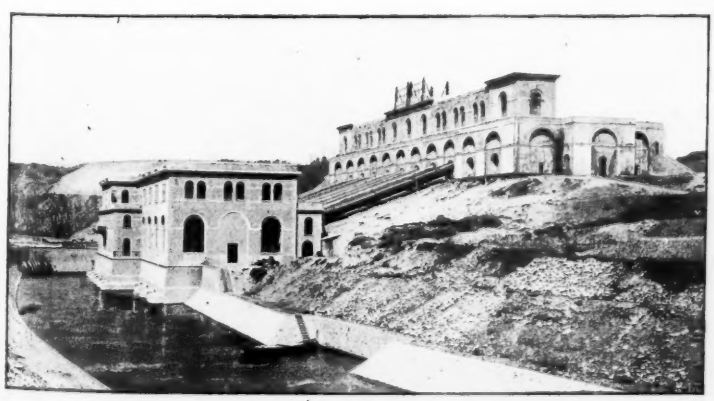
One of the most interesting installations visited by the Institution of Electrical Engineers, during their recent pilgrimage to Italy, was the huge power station of Vizzola, on the River Ticino. This plant is especially noteworthy, in that it is used for the generation of power for distribution at very high pressure, over a large area, forming a close parallel, in fact, with the many power distribution schemes which have been promoted in this country. The energy distributed is not applied to the lighting of towns so much as to the supply of motive power to the cotton and silk mills and other manufacturing works and industries of this part of Lombardy. Many of these works formerly derived their motive power from the falls of the River Olona, but this was soon exhausted, and had to be supplemented by steam plant, in spite of the heavy cost of coal. Hence the development of electric power transmission, which rendered possible the utilisation of the immense natural energy of the Ticino and other rivers, has been of the utmost benefit to this busy and populous district, the industrial centre of Italy. The scheme was planned and carried out by the Società Lombarda per Distribuzione d'Energia Elettrica.

Although the Ticino had previously been practically untapped as a source of energy, its waters had been largely availed of for irrigation purposes for generations past; and the Società Italiana per Condotte d'Acqua, about 20 years ago, carried out important works at a point about 5 km. above Vizzola for the derivation of an irrigation canal called the "Canale Villoresi," which runs along near the left bank of the Ticino. When these works were executed, provision was made for the future construction of an industrial canal, which takes its rise from the same forebay, and runs parallel with the irrigation canal, as far as the hydro-electric power station. One of our illustrations gives a view of the intake, showing the weir, which is 290 m. wide and 4 m. high, and the sluice gates, which are capable of passing about 200 m^3 of water per second. The forebay is 600 m. long, and is provided with a spill-way leading surplus water into the river. The industrial canal is also navigable, as the

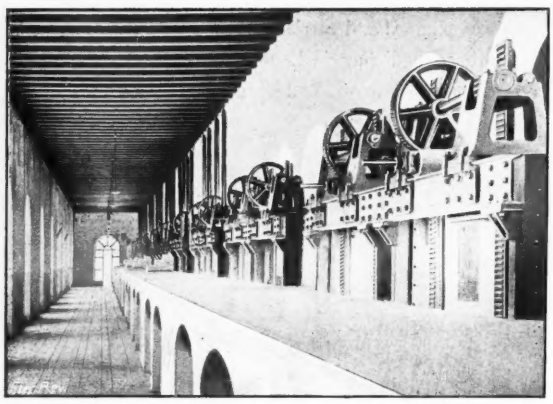
Vizzola: Weir and Forebay.



Vizzola: Interior of Power Station.



Vizzola: Exterior of Works.



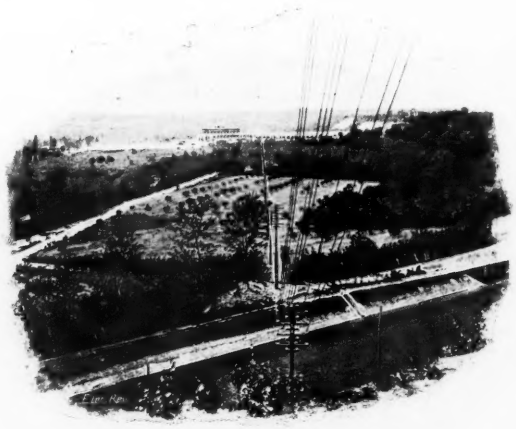
Vizzola: Gear for Controlling Sluice Gates.

On one side of this is a spill-way, allowing surplus water to fall in successive stages to the river level, while the other side is occupied by the penstocks and sluice gates controlling the turbines. The adjoining view shows the gallery in this building containing the gear for controlling the gates, which can be operated both electrically and by hand.

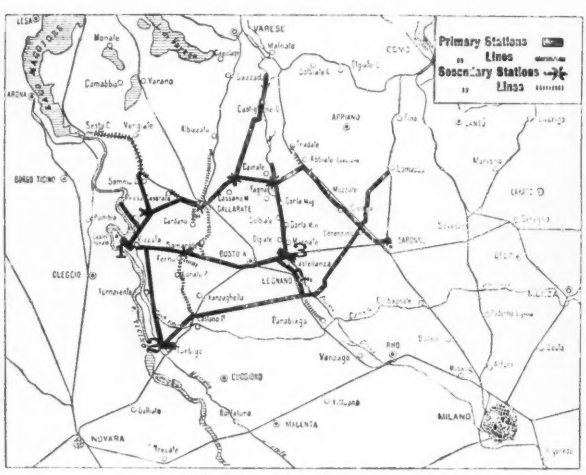
The water is led to the turbines by 12 steel pipes, supported above-ground, as shown in our views of the exterior of the station; leaving the turbines, it is carried away by a tail-race to rejoin the navigable canal, and falls into the river at a short distance from the station.

The generating plant consists of 10 generators and three exciters, coupled direct to turbines. Of the latter, eight were built by Messrs. A. Riva Monneret & Co., of Milan, and two by Messrs. J. M. Voith, of Heidenheim, of 2,000 H.P. each, running at 187 r.p.m.; all of them are designed for a head varying from 24 to 28 m., and they are all of the reaction

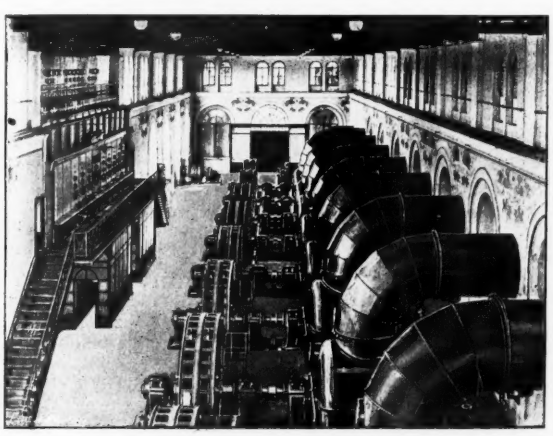
High-Pressure Lines Passing Under Bridge.



Transmission Line from Power Station.



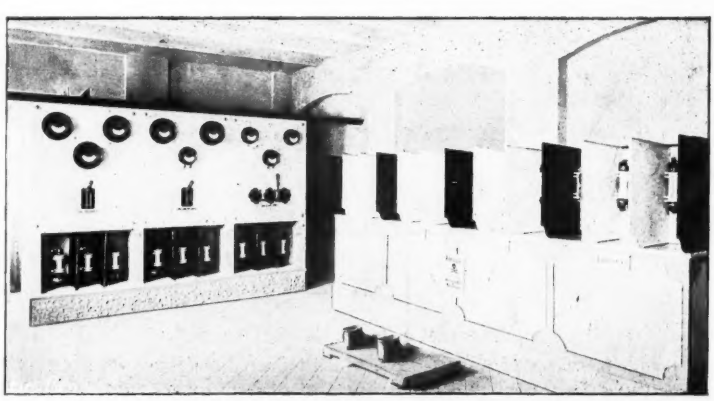
Map of Area Supplied.



Another View in Power Station.

members of the Institution party will pleasantly remember, for it was along this waterway that they were conveyed in barges from the intake works to the power station, the journey being beguiled by a most enjoyable repast, which led to the bestowal of the title "alimentary canal" upon the aqueduct.

The canal is about 6 km. in length from the forebay, and has a capacity of 80 m^3 per second, with a fall of ·015 per cent. The total head of water available is 30 m., which is diminished to 26 m. in flood-time, and the brake horse-power obtainable from the turbines at all times is about 18,000 H.P. At a point near the power station the navigable canal is separated from the power canal, and descends by three locks to the river, while the power canal is carried by a fine aqueduct to the forebay of the station.



Interior of a Sub-station.

type, with horizontal axes and two rotors, the admission being radial from without, and the discharge central with draught tube. The speed is automatically regulated by a governors and servo-motors, of the hydraulic type in the case of the Riva Monneret turbines, and mechanical in the case of the Voith machines. The turbines coupled to the exciters were made by Messrs. Riva Monneret & Co., and are of 220 H P. each, running at 300 r.p.m. They are provided with fly-wheels on the shafts and elastic couplings, and are controlled by governors with mechanical servo-motors.

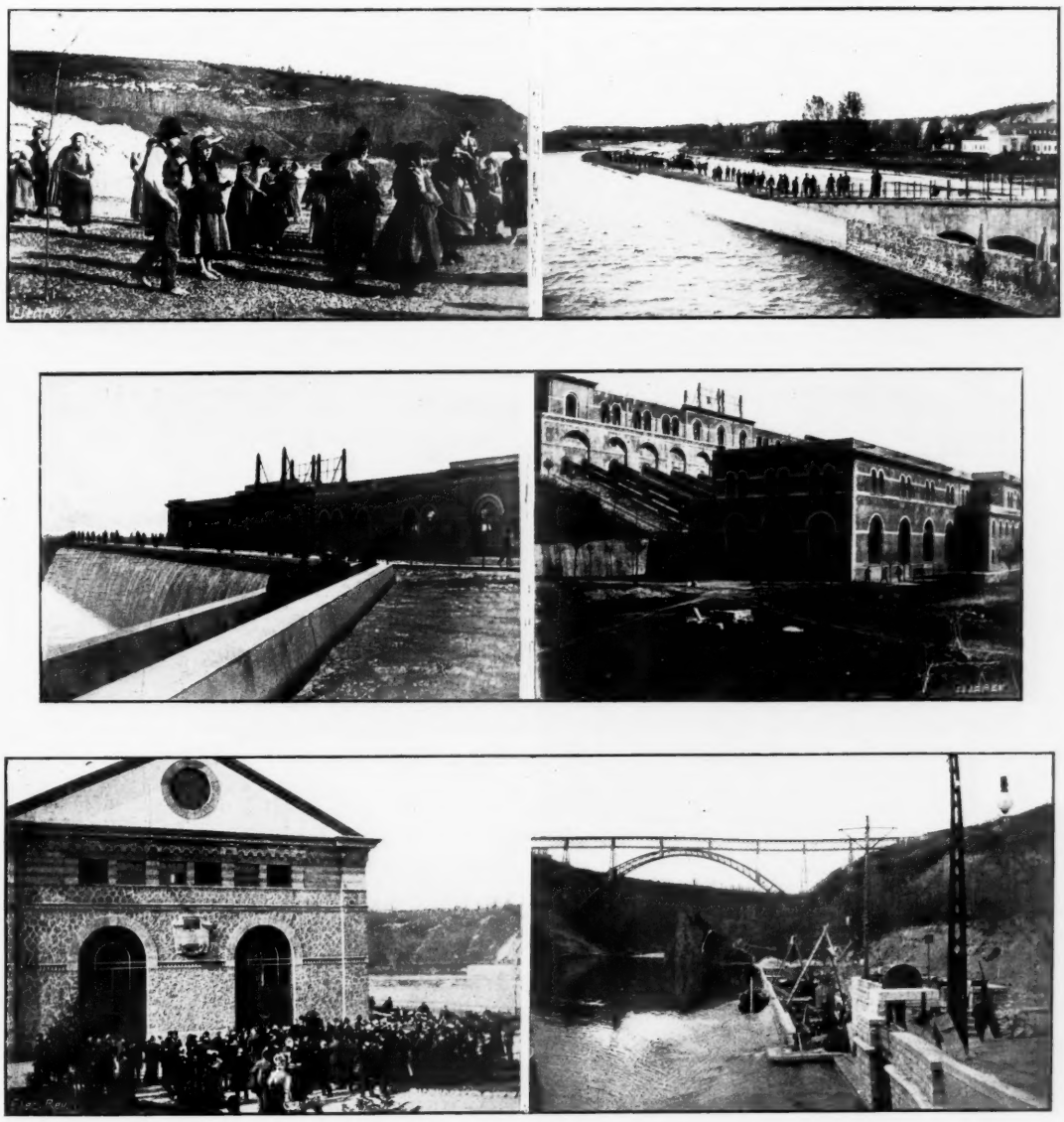
The electric generators were supplied by the E.A.G. v. Schuckert & Co., of Nuremberg ; they are coupled direct to the turbines, and are of the rotating field type, most of them having a single exciting coil after the Kapp design. They generate three-phase current at a pressure of 11,000 volts and a frequency of 50 cycles per second ; the normal output of each generator is 1,650 KW. The armature frames are of light construction, the necessary strength being given by transverse steel tie-rods.

The long row of turbines and generators, with the huge steel tubes conveying the water to the former, has a very fine and imposing appearance, the effect of which is intensified by the curious rushing sound which always proceeds from these large hydro-electric sets, while the absence of any reciprocating mechanism, with its attendant pulsation, adds to the peculiarity of the installation in the eyes of a Britisher.

The exciters are of 145 KW. each, working at 110 volts.

The switchgear is situated in two rooms abutting on the dynamo room, the operative faces of the switchboards being accessible in the latter by means of a gallery and stairways. The generator switchgear is placed in the lower room, and the feeder gear above. The feeders go from the switchboard to the lightning arrester equipment, always such a prominent feature in these undertakings, which is housed in a separate building. As shown in our views, the high-pressure conductors pass over the top of the building at the forebay. The feeder system comprises 10 three-phase lines, which run to Varese, Gallarate, Lomazzo, Legnano, Turbigo, &c. ; they are carried on triple-petticoat porcelain insulators, mainly on wooden poles, with iron poles at intervals in the proportion of 1 in 3, and have a total length of 140 km. As far as possible the lines follow straight routes across country, but in some cases they are erected by the side of the roads.

In 20 of the principal consuming centres, where the consumers are numerous and the plants small, transforming



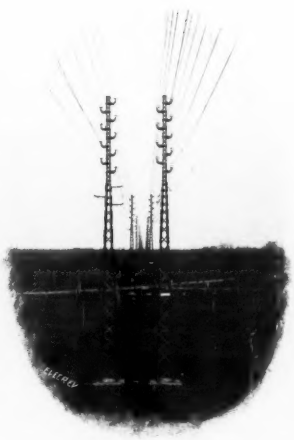
1. A native escort at Vizzola.
2. The party at the Vizzola power canal.
3. The Spill-way at Vizzola.
4. Exterior of Power Station, Vizzola.
5. Unveiling memorial to Enrico Carli, at Paderno.
6. Intake of Paderno power canal.

Institution of Electrical Engineers in Italy.

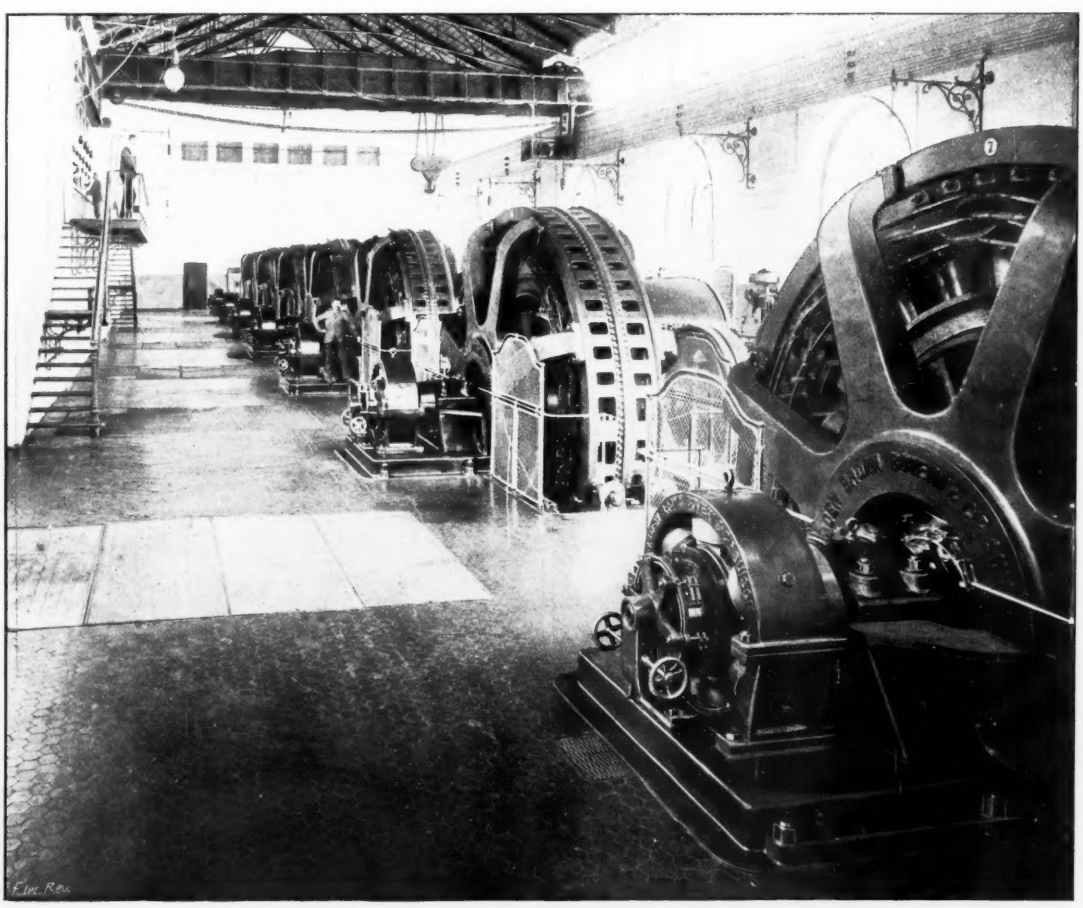
stations are provided, of 200 KW. capacity each, where the pressure is reduced to 3,600 volts, for supply through a secondary network of a total length of 25 km. The larger users, however, have their own transforming plant, taking power direct from the primary lines at 11,000 volts, and reducing the pressure to 500 volts. There are, in all, 98 transforming stations connected with the primary lines, having a total capacity of 15,500 KW. The consumers number 2,400, and are distributed through 66 communes. The motors are 750 in number, and the glow lamps 15,000.

The supply of power available from Vizzola is already insufficient to cope with the demand, and the Società Lombarda has commenced the erection of a second hydro-electric station at Turbigo, on the Ticino, 15 km. further down stream, where a power of 6,000 H.P. will be obtained. A third station is also in course of erection at Castellanza; this will be steam-driven, and will have an output of 6,000 H.P.

PADERNO: EXTERIOR OF POWER STATION.



TRANSMISSION LINE.



PADERNO: INTERIOR OF POWER STATION.

Not less interesting in many ways was the large hydro-electric power station which has been erected at Paderno by the Società Italiana Edison di Elettricità, the oldest company formed for the public supply of electricity in Europe, and one of the most successful. As long ago as 1883 the company commenced operations in Milan, where the world-famed Edison "Jumbos" were originally installed, and ten

years later the company opened an electric tramway in the same city. The inhabitants so readily appreciated the conveniences and utility of electricity that the demand continually increased, until, in 1895, the company was obliged to erect a new steam power station in the city, and, at the same time, commenced the construction of the Paderno generating station and hydraulic works, which were finished three years later. The Paderno station is situated on the River Adda, about 33 km. from Milan, and 2¼ km. from the headworks. At present the latter are in course of alteration, it being intended to raise the level of the weir by 1 metre in order tc increase the quantity of water available. The power canal is of an unusual character, a considerable part of its length being in tunnel; it is at present used for conveying about 54 m^3 per second, but will carry a larger quantity per second when the alterations and extensions are completed.

From penstocks situated on the hillside above the power station, the water is carried down to the latter by seven steel pipes, 1·2 m. in diameter, feeding an equal number of generating sets. The surplus water is carried away by a spill-way in the form of a staircase, by the side of the station. The generating plant consists of seven turbines of the reaction type, made by Messrs. Riva, Monneret & Co., of Milan, coupled to three-phase alternators of 1,500 KW. each, made by Messrs. Brown, Boveri & Co., of Baden. The effective head of water is 29 m., including about 6 m. in the draught tubes, and the turbines run at 180 r.p.m. They are controlled by hydraulic governors, which act upon moving vanes in the admission channels, within a range of 2 per cent. in ordinary working. The governors can also be adjusted by means of small motors from the switchboard when paralleling. The alternators are of the revolving magnet type, and are driven through Zodel elastic couplings. The magnet wheel carries 28 laminated poles, giving a frequency of 42 cycles per second. The stationary armature is wound for a pressure of 14,000 volts, the winding being carried in one hole per pole per phase; the ends of the coils are alternately straight, bent up and bent down, slightly overlapping the magnet wheel. The armature frame is carried by cast-iron arms from hubs mounted on the main bearings, so that the whole armature can be rotated, if desired, bringing any part of it into a position convenient for inspection. Further, the frame is divided on the horizontal plane in such a way that the upper half can be removed without removing any of the coils. The exciter armatures are carried on the ends of the main shafts of the generators.

The switchgear is housed in a room opening on to the generator room, the main generator switchboard being nearly flush with the wall of the latter, and mounted on a gallery. An elaborate system of Wurts lightning arresters is provided in a room above the switch room.

The transmission line consists of two rows of iron lattice standards, carrying 18 copper wires each 9 mm. in diameter on porcelain insulators; the poles are 60 m. apart, and the two rows are separated by a distance of 2 metres. Besides the main line to Milan, branch lines are carried to substations at Brianza, Monza and Sesto S. Giovanni, the last being a converting station for the Milan-Monza electric tramways, which are owned by the same company. The three branch lines supply motors of a total capacity of 2,944 H.P., as well as 16,760 glow lamps, and 91 arc lamps.

At the Porta Volta station, Milan, to which we shall refer later, the high pressure is reduced to 3,700 volts for paralleling with the main bus-bars, with which the steam-driven sets are also connected.

Thanks to the large number of motors supplied, the tramways in and around Milan, and the free use of storage, the plant at Paderno is kept fully loaded throughout the day, and the utmost advantage is derived from the water-power available.

Belgium.—Under the name of La Chambre Internationale de l'Extension du Commerce et de l'Industrie an association has just been formed in Liège. The objects of the new undertaking are to look after the interests of foreign merchants and traders in Belgium, to furnish commercial information, recover debts, act as agents, &c. It has also taken over a small electrical engineering business in Liège.

ELECTRIC LIGHT AND POWER NOTES.

(*Continued from page* 142.)

Limerick.—Last week the L.G.B. held an inquiry with reference to the application of the Corporation for sanction for a loan of £7,000 to complete and extend the electric lighting installation.

Lowestoft.—The T.C. has fixed the minimum charge for energy for power purposes at 10s. per quarter, exclusive of meter rent, and has abolished the minimum charge for ordinary lighting.

Manchester.—On the 13th inst., in Piccadilly, an explosion occurred in an electrical joint-box opposite the Wellington Monument, and a linesman was burned about the hands.

Mansfield.—At a meeting of the T.C. on Friday last it was decided to hold an electrical exhibition in the autumn. Upon the recommendation of the E.L. Committee it was resolved to apply to the L.G.B. for sanction to borrow £15,000 additional capital, and the Finance Committee was requested to include in its application a consent order for the issue of stock to the amount of £60,000 in respect of the capital expenditure on account of the electrical undertaking. The borough electrical engineer was instructed to report as to the hire-purchase system with regard to motors.

Northampton.—The T.C. has decided to consent to a prov. order being granted to the Northampton Electric Light and Power Co. for the supply of electricity within the borough.

Provisional Orders.—Notices of application for prov. orders have been lodged by the Empire E.L. & P. Co. for Sutton-in-Ashfield (Notts.), Clay Cross, Caerphilly, Abercarn, Rawmarsh, Widnes, Thames Ditton, Cleethorpes, Hampton, Farnborough, Forfar, and East Molesey; by Messrs. Lewis & Fletcher, for Caerphilly; by the Western Electric Distribution Corporation, for Wells; by the Southern District Electricity Corporation, for Shepton Mallet, Wells, Wimborne, Bridport, St. Ives, Swanage, Saffron Walden, Chertsey, Alton, Eastleigh and Ross; by Messrs. Edmundson's Electricity Corporation, for Ham; by the Saffron Walden Electricity Supply Co., for Saffron Walden; by the Sir Hiram Maxim Electrical and Engineering Co., Ltd., for Farnborough, Farnham and Chertsey; by the Twickenham and Teddington Electricity Supply Co., for Thames Ditton, Hampton Wick, East Molesey and Sunbury; by the Swanage and District Electric Supply Co., for Swanage; by the Inland Waterways, Ltd., for Farnham, Chertsey, and Eastleigh; by the Abingdon and District Electrical Supply Co., for Abingdon; by Mr. E. P. Harvey, for Hexham; by the Clyde Valley Electrical Power Co., for Milngavie; by the Eastleigh and District Electric Supply Co., for Eastleigh.

Pudsey.—The E.L. Committee has recommended the Council to establish a refuse destructor and electric lighting scheme, at an estimated cost of £11,000, and to apply to the L.G.B. for permission to borrow the money.

Shrewsbury.—The T.C. has reduced the price of energy for private lighting from 7d. to 6d. per unit as from July 1st.

Southampton.—On Monday, Mr. W. Bone, formerly Mayor, laid the foundation stone of the new electricity works.

Spain.—Vice-Consul Naftel reports that the town of Aguilas is now lighted by electricity. The machinery and plant are of Westinghouse make, imported from the United States. The undertaking is in the hands of a Spanish company. The distribution of energy is by triple conductors; there are two continuous-current series-wound dynamos of 37½ KW. each, coupled to anthracite gas engines of 125 H.P. The present supply is for 2,500 lights.

Consul-Agent Walker reports that the town of Motril is now lighted by electricity, but complaint is made that the light is both dear and of inferior quality. It would seem, he remarks, that the water-power employed for the purpose at the neighbouring village of Velez was not nearly sufficient, and the possibility is suggested of the water failing during hot weather.

Stourbridge.—The U.D.C. last week decided that the Council should forthwith put into effect the decisions arrived at in July, 1900, and June, 1902, to retain and work the electric lighting prov. order, and that a special committee be appointed for that purpose. This means that the terms offered by the Midland Electric Corporation for Power Distribution, Ltd., to carry out the order are not accepted.

Ulster.—A scheme is on foot which, if carried to a successful issue, will have an important effect upon the industrial development of the province of Ulster. A company, composed of Belfast and London commercial men, has been registered for the purpose of promoting a Bill to authorise the formation of a corporation that will undertake the supply of electrical energy in Ulster. The districts to be developed contain quarries, canals, tramways, railways, engineering works, shipyards, spinning mills, and a variety of other works. At present most of these are steam-driven. The advising engineers to the company are Messrs. Preece and Cardew, of London.

Urmston.—The U.D.C. having received a report from Mr. C. H. Wordingham, has decided that it would be inadvisable for the Council to undertake the supply of electricity. We have had occasion before to congratulate Mr. Wordingham on his single-minded candour in dealing with municipalities, and laying the naked truth before them, shorn of the usual optimistic estimates of "the profit in the *n*th year of working." We can only regret in the public interest that he has retired from consulting practice, though we are glad to think that he has entered the public service in a still more important capacity.

Wednesbury.—The T.C. has decided to invite offers from private companies and firms for undertaking free and hire-purchase electric wiring and motors in the borough.

Whitehaven.—The T.C. has fixed the following scale of charges for the supply of energy from October 1st, 1903:—Fixed charges of £12 a year, and 2d. per unit by meter, to be reduced to £8 and 2d., and the uniform charge from 6d. to 4½d. per unit.

A loan of £2,500 has been applied for to carry out extensions.

Willesden.—Applications to hand for lighting and power total 12,656 8-C.P. lamps. It is expected that, at the end of the first year's working, the estimate of the electrical engineer of 19,833 lamps will be exceeded. At the last meeting of the District Council the present charge for lighting of 1½d. per unit after the first hour's use of the maximum demand was reduced to 1d., while the charges for power were reduced to the following scale:—For a maximum demand in any quarter not exceeding 3 H.P., first hour 6d., afterwards 1d.; 3 to 20 H.P., 5d. and 1d.; exceeding 20 H.P., 4d. and 1d.; special rates for over 100 H.P. The electrical engineer was instructed to report upon a proposed addition to the plant of a 600-KW. steam dynamo, with the necessary foundations, condenser, &c.

ELECTRIC TRACTION NOTES.

Birmingham.—It is stated, in a Leeds paper, that the Corporation of Birmingham offered Mr. J. B. Hamilton, the general manager of the Leeds Tramways, the position of manager of the tramways in that city, at a salary of £1,500 a year; but the Leeds Tramway Committee decided to increase Mr. Hamilton's salary from £900 to £1,200 a year, and to add £100 a year during the next three years, making the salary £1,500 in 1906.

Farnborough. — The ratepayers of the town have unanimously decided to support the B.E.T. Co.'s scheme for an electric tramway through the district from Bromley.

Flint.—The T.C. has passed a resolution heartily endorsing the general principles of the scheme for providing an electric tramway on the overhead system from Sandycroft, through Flint to Holywell, Mold and Buckley and back to Connah's Quay. The scheme has been brought forward by a Manchester company.

London.—The work of reconstructing the short section between Kennington Gate and the beginning of the cable in Brixton Road is practically complete, with the exception of the paving, and last week several experimental trips were made with the new cars. We read in the *Daily Chronicle* that some slight difficulties have arisen, for the transformation at the junction of the two systems is a departure, and cannot be got into working order all at once. "The plough through which the car motors receive the electric current has to be raised, and the cable 'gripper' is then run under the car and fixed in the manner which is familiar to all who use the present service. On the return journey the reverse operation takes place, the 'gripper' being released and the plough replaced in position. The Council's engineer has devised an ingenious system by which at the point of transformation the electric and the cable slots are for a little distance side by side, the former being diverted towards a hatchway in the road through which the plough can be reached. It is expected that the delay in fixing will be very slight. As soon as the line has been inspected by the Board of Trade, the new trams will be run from Westminster at first and afterwards from the other termini."

L.C.C.—On Tuesday Mr. J. W. Benn, in reply to a question as to tramways to the City, stated that a week ago he had an opportunity of waiting upon the Streets Committee in regard to a tramway service over Southwark Bridge. He was altogether delighted with the reception he met with on that occasion. It only required the support of the two City members near him, and he thought the Council would be able to get over the bridge without breaking down the City tradition that no tramway should enter the City.

The adjourned report of the Highways Committee was brought forward in reference to a proposed application to Parliament for powers to construct new tramways of a total length of 29¼ miles, and to double and reconstruct existing lines of a length of about 3¾ miles. It was intended, with two exceptions contemplated as trolley lines, to equip the tramways on the underground conduit system. The total expenditure on the tramways would amount to £1,580,325, and on the incidental street improvements to £722,230. In a separate report the Finance Committee stated that most of the schemes were revivals of former proposals which were dropped on account of the refusal of the local authorities to sanction the tramways, or, in some cases, to contribute towards the cost of the road improvements. In many cases the consents of the local authorities had not yet been received, and it was more than probable that the list would be considerably reduced before the proposed Bill came before Parliament. The only new proposals were four in number, which accounted for a total gross outlay of £564,600. After discussion the Council adopted the report of the Committee, and decided to apply for powers in the next session for the following lines:—(1) Hampstead Road; (2) Westminster Bridge Road; (3) Southwark Street; (4) Waterloo Road; (5) Goose Green, Camberwell; (6) Trafalgar Road, Greenwich, to East India Dock Road; (7) Shepherd's Bush Road, *vid* Westwick Gardens, to Marble Arch; (8) Edgeware Road to Cricklewood; (9) Battersea Park Road to Chelsea; (10) Clapham Common, south side, to East Hill, Wandsworth; (11) Streatham High Street to the county boundary; (12) Tooting High Street to the new county boundary; (13) Lordship Lane to Forest Hill; (14) Lewisham High Road to Forest Hill; (15) New Cross Road to Lee Green; (16) Deptford to the Herbert Hospital, Woolwich; (17) Reconstruction and partial doubling of the tramways of the Woolwich and South-East London Tramways Co., from Beresford Square, Woolwich, to Plumstead, and construction of new tramways thence to the county boundary near Abbey Wood railway station; (18) Doubling of existing L.C.C. Tramways from London Street, Greenwich, to the terminus at Rushey Green.

Warrington.—The T.C. intends to apply to the Board of Trade for an extension of time until August 6th, 1904, for the completion of the works authorised by the Tramways Order, 1900.

Wolverhampton.—The tramway difficulty is still in a chaotic state. It is now over two months since the Town Council, by a substantial majority, decided to get rid of the Lorain system, and to adopt the overhead system of electric traction, but up to the present time no visible advance has been made in that direction. What the members of the Tramways Committee are doing it is impossible to divine. There have been many secret conclaves, but not a whisper is heard. The proceedings are guarded like State secrets. It is understood, however, that the sub-committee, composed exclusively of members favouring the Lorain Co., have recently met the local representative of that company (Mr. Wetmore) more than once. There has been nothing in the nature of a conference. The company insisted that the Corporation should put their proposals in writing. It is stated that on Tuesday week, the 14th inst., an offer was put before the company, and it was straightway cabled to America. A reply was received on Saturday afternoon, and it is believed to have been unsatisfactory. Another proposal—and a better one—was cabled the same day; but up to the time of writing no response has been received. The nature of the proposal may be gathered from the fact that when in London the sub-committee invited the Lorain Co. to run the trams for a limited period—it is alleged the time mentioned was five years—and to pay the Corporation a rental. This was declined. Then the company were asked whether, supposing the Corporation paid the company, say £10,000, they would accept that sum in settlement, and abandon arbitration. This was promptly pooh-poohed; the company pointed out that they had fulfilled their contract, and claimed £24,000. They also complained that the Corporation had not pointed out wherein the company had failed, as the Corporation alleged, to carry out their obligations. The two proposals which have since been made, therefore, are believed to embrace the offer of two specific sums between the £10,000 and £24,000 already mentioned. It is contended by those who are opposed to the Lorain system that the sub-committee have been exceeding their powers, and that though the Town Council instructed the Tramways Committee to enter into negotiations with the company for the purpose of avoiding arbitration, it did not authorise the Committee to make overtures to the company to run the trams and pay the Corporation a rental. The public are certainly irritated at the present delay, which, however, is unavoidable in dealing with a company whose headquarters are at New York, and who have only agents in this country. It is becoming more and more apparent that the company feel they have a strong case to go before the arbitrator, whilst the members of the Tramways Committee favourable to the Lorain Co. have seriously damaged the case for the Corporation by their reckless and indiscreet utterances. A leading member of the Tramways Committee—one who has been an advocate of the Lorain system—declared the other day that the Corporation were in a hopeless muddle, and the difficulty now was to get out of it.

TELEGRAPH AND TELEPHONE NOTES.

Anglo-French Telephonic Communication. — Sir George Murray has addressed a letter to the Association of Chambers of Commerce with reference to the establishment of telephonic communication between provincial towns in England and France, and also between provincial towns in each country and the capital of the other. He says that "the arrangements are almost completed, and it is hoped that the service will be opened in the course of this month."

Brighton Telephones.—The Corporation Telephones Committee has decided to apply to the L.G.B. for a loan of £3,000 in connection with the extension of the municipal telephone system to Hove.

Telegraph Cable Imports.—The imports of foreign telegraph cables and apparatus connected therewith into this country during last month amounted to £3,522 as compared with only £979 in the preceding month. For the six months ending with June last such imports have attained a value of £30,140.

Cable Service between Japan and the Sandwich Islands.—The report of Mr. H. G. Parlett, Acting Japanese Secretary to His Britannic Majesty's Legation, Tokio, states that on January 5th, 1903, the Pacific cable service between Hawaii and San Francisco, which by July is to be extended to Manila, was opened. Messages can now be sent from Japan to the Sandwich Islands in a matter of 15 hours, whereas formerly they took over a week. The rate per word *viâ* Vladivostock is 4 yen 88 sen (10s.), *viâ* Shanghai 5 yen 68 sen (11s. 6d.).

International Telegraph Rules and Rates.—The following has been issued from the General Post Office:—The International Telegraph Conference which has recently been sitting in London has completely revised the rules as to the use of code and cipher language in international telegraphy. The decision of the last conference that code telegraphy should, after a certain date, be limited to the words contained in the official vocabulary prepared by the International Telegraph Bureau has been rescinded; and, whilst all the words conforming to the existing rules will still remain available for use in code telegrams, the area of selection will be largely extended. In future, any combination of letters not exceeding 10 in number will be passed as a code word, provided that it is pronounceable according to the usage of any of the languages to which code words have hitherto been limited, namely, English, French, German, Dutch, Italian, Spanish, Portuguese and Latin. Other combinations of letters will be counted at five letters to the word, the prohibition of letter cipher which has hitherto prevailed being now removed. The grant of these facilities will not, of course, admit of combinations being formed by the running together of *bonâ fide* words.

The public are recommended to avoid the use of letter cipher as far as possible in the compilation of their codes, as it is less easy to transmit than pronounceable groups of letters, and therefore more liable to error. In cases where such cipher may be employed it will be advisable to arrange it in groups of five letters in order to facilitate transmission. These alterations, together with a number of other changes in the detailed regulations, which will be announced in due course, will take effect on July 1st, 1904.

The following reductions of rate have been arranged:—

	From.	To.
	s. d.	s. d.
EUROPE.		
Bosnia-Herzegovina	0 4	0 3½
Crete	0 6½	0 6
Gibraltar	0 3½	0 3
Greece	0 6½	0 6
Malta	0 6	0 4½
Montenegro	0 4	0 3½
Portugal	0 3½	0 3
Russia	0 5½	0 4½
Spain	0 3½	0 3
AFRICA.		
Tangier	0 5	0 4½
Tripoli	0 8½	0 7
West Coast:—		
Gold Coast—Accra and Sekondi	5 7	4 8
Other places	5 9	4 10
Nigeria—Brass, Bonny, and Lagos	6 3	5 0
Other places	6 5	6 2
Sierra Leone	4 6	3 6
ASIA.		
British Borneo—Labuan	5 0	3 6
Other places	5 3	3 9
China and Hong Kong	5 6	4 5
Corea: Chemulpho, Fusan, and Séoul—		
via Great Northern Co.	6 2	4 10
„ Eastern Co. / „ Indo-European Co.	7 9	5 8
Other places—		
via Great Northern Co.	6 6	4 10
„ Eastern Co. / „ Indo-European Co.	8 1	5 11
Formosa	6 2	4 10
Japan—*via* Great Northern Co.	6 2	4 10
„ Eastern Co. / „ Indo-European Co.	7 9	5 8
PHILIPPINE ISLANDS.		
Luzon	5 9	4 5
Other Islands	6 2	4 10

The reductions to China, Corea, Formosa, Japan, and the Philippine Islands have already come into force; the others will take effect not later than July 1st, 1904.

New Pacific Cables.—Consul-General Bennett, in his report on the trade and commerce of California and the neighbouring States, comments on the importance of the telegraphic cable to California, which country, he points out, now looks not so much to the Eastern States of America as to the Orient as her market of the future. One of the most important factors in this movement was the opening, in January of this year, of the cable to Honolulu, whence, at an early date, it will be carried on to the Philippines, and thence to a Chinese port. Mr. Bennett says that the laying of the Manila cable, coinciding as it did with the opening of the Australia to Canada cable, cannot but foreshadow a great increase of American competition in Australia and the Far East. The Farallon Islands had been placed in telegraphic communication with the mainland. The islands are situated 26 miles outside the entrance to San Francisco Bay.

Telephones in St. Lucia.—According to the official report on the Blue Book of the colony of St. Lucia for the year 1901, just issued, the only improvement to the telephone system during the year was effected by the substitution of 145 iron rails for rotten wooden poles. The old poles, it is stated, are being replaced gradually, as funds will allow, by the erection of a few miles each year of iron poles with larger copper wire. Telephonic communication with the island compares very unfavourably with the system in other parts of the West Indies, and constant complaints are made respecting it. To make it a satisfactorily working and paying department, a considerable additional expenditure is said to be necessary.

Telegraphic Interruptions and Repairs:—

CABLES.	INTERRUPTED.	REPAIRED.
Latakia-Cyprus	June 20, 1899	
Trinidad-Demerara No. 1	Aug. 27, 1901	
Dominica-Martinique	May 8, 1902	
St. Lucia-Martinique	May 8, 1902	
Guadeloupe-Martinique	May 9, 1902	
Martinique-Puerto Plata	July 10, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
St. Lucia-St. Vincent	Sept. 19, 1902	
Reissa-Issa	Oct. 22, 1902	
Reissa-Yemani	Oct. 22, 1902	
Paramaribo-Cayenne	Feb. 27, 1903	
New York-Haiti	April 13, 1903	
Siteebondo-Bandjermasin	July 6, 1903	
Zanzibar-Mombassa	July 16, 1903	
LANDLINES.		
U.S. of Colombia:—Landlines to Dagua	July 14, 1903	
Irkoutsk-Werkhne Oudinsk	July 17, 1903	July 18
Corea:—Landlines beyond Fusan	July 20, 1903	July 21

Wireless Telegraphy.—A Reuter dispatch from St. Petersburg says that a wireless telegraphy station has been established at Golden Mountain, Port Arthur, with the object of organising regular telegraphic communication between Port Arthur and Russian warships in the Gulf of Pe-chi-li.

The Prince and Princess of Wales last Saturday paid a visit to Poldhu, and together with Mr. Marconi inspected the wireless telegraph station and apparatus there. The Marconi Wireless Telegraphy Co. sent messages of homage from the Lizard station to the Prince and Princess, who ascended the principal of the four towers, the Prince going to the summit, but the Princess contenting herself with the second landing.

The following taken from the *Westminster Gazette* is really lovely. It needs no comment. Our readers will know what to think:—"'It's an ill wind——!' The breakdown of the Transatlantic Marconigram service a few months ago *may, it is now believed* result in a much-improved system. It was stated at the headquarters of the Marconi Co. that Mr. Marconi, while superintending alterations necessitated by the breakdown, incidentally made discoveries which will greatly facilitate the sending and receiving of long-distance messages. The inventor has, therefore, decided to apply these discoveries to his system before it is opened for public use. Some months must elapse before the new methods can be introduced. Meanwhile, however, private messages, it is now declared, are being sent from England to Canada and from Canada to England daily."

CONTRACTS OPEN AND CLOSED.

OPEN.

Atherton. — July 28th. Electricity meters for the U.D.C. See "Official Notices" July 17th.

Bath.—July 27th. Main switchboard for the new generating station. See "Official Notices" July 17th.

Birkenhead.—July 28th. One 350-KW. direct current steam dynamo for the Corporation. See "Official Notices" July 17th.

Belgium.—Tenders are at present being invited by the Belgian State Railway Authorities at the Bourse, Brussels, for the establishment and equipment of a plant for electric lighting and power purposes at the railway workshops at Namur.

Blackburn.—July 27th. Main switchboard and accessories. See "Official Notices" July 10th.

Brighton.—August 10th. Electricity meters for one year. See "Official Notices" to-day.

Edinburgh. — August 3rd. Arc lamp-posts. See "Official Notices" to-day.

Guadeloupe.—August 29th. Tenders are being invited until August 29th next by the municipal authorities of Point à Pitre (Guadeloupe) for the concession for the public and private electric lighting of the town.

Hungary.—August 31st. Tenders are being invited until August 31st next by the municipal authorities of Besztercsebanya (Neusohl) for the establishment in the town of a centra electricity generating station of a capacity of 500 H.P.

Launceston (Tasmania). — September 28th. 500 or more electric meters. See "Official Notices" June 12th.

Leeds.—August 7th. Messrs. Graham, Morton & Co., Ltd., want tenders for the necessary electric cables, fittings, &c., for their new works. See "Official Notices" July 17th.

London.—August 11th. Low tension feeder switchboards for the tramways sub-stations in Camberwell and New Cross. See "Official Notices" July 10th.

London. — October 6th. Four 5,000-H.P. vertical-horizontal steam engines, each suitable for driving a three-phase generator, for the Greenwich power station. See "Official Notices" to-day.

New South Wales. — September 12th. Tenders are being invited by the Railway Commissioners for New South Wales, for an additional generating set of 1,500 KW. for their tramway power station.

Pietermaritzburg.—July 29th. Six each single-deck bogie and double-deck single-truck cars for the Corporation. See "Official Notices" July 3rd.

Portugal.—October 21st. Tenders are being invited until October 21st by the Portuguese Ministry of the Colonies in Lisbon for the concession for the electric lighting of the town of Macao in the Portuguese Colonies.

Rochdale. — July 28th. Copper rail bonds. See "Official Notices" July 17th.

Rochdale.—August 10th. Sixteen double-deck double-truck, 20 double-deck single, and 5 single-deck combination cars. See "Official Notices" to-day.

Spain.—July 26th. The Spanish Post and Telegraph Authorities in Madrid are inviting tenders until the 26th inst. for the supply of 25 Hughes telegraphic apparatus. Tenders are to be sent to La Direccion General de Correos y Telegrafos Carretas, 10, Madrid, whence particulars may be obtained.

Stockport. — August 4th. Tools, &c., for car-shed, workshops. See "Official Notices" to-day.

Wednesbury.—July 30th. The Corporation wants offers for free and hire purchase electric wiring and motors. See "Official Notices" July 17th.

CLOSED.

Bradford.—The Corporation has accepted the offer of the B.T.H. Co. to supply 11,600 incandescent lamps, for free supply to customers during the half-year ending December, for the sum of £445. A sample order has also been placed with Messrs. Crompton and Co., Ltd., for 1,000 lamps.

The Corporation has accepted the tender of the Phœnix Dynamo Manufacturing Co., Ltd., for a 300-KW. generator for the sum of £700, and the tender of Messrs. Willans & Robinson, Ltd., Rugby, for a 500-H.P. high-speed engine, required for the driving of this generator, for the sum of £1,399.

Brighton. — The T.C. has received tenders from the following firms for plant for the Southwick and North Road power stations:—General Electric Co., £96,213; British Westinghouse Electric and Manufacturing Co. (accepted), £80,426; Witting Bros. and Eborall, £88,000.

Hammersmith.—The B.C. has accepted the tender of Bruce Peebles & Co. for the supply of a special transformer, at £243.

Hampstead.—The B.C. has accepted the following tenders for 12 months' supplies:—St. Helens Cable Co., high tension, house service and rubber cable; Henley's Telegraph Works Co., three-core cable.

London. — The following tenders were received for supplying and fixing a lighting installation, power mains, telephone system and cinematograph mains, &c., at the new offices of the Canadian Pacific Railway Co., in Trafalgar Square, to the specification of Mr. L. Alwyn, consulting engineer:—Drake & Gorham, Ltd., £490: Strode & Co., £497: Frank Suter & Co., Ltd., £612; The Brush Electrical Engineering Co, Ltd., £600; Donnison, Sillem & Co., £407 10s.; The Alliance Electrical Co., Ltd., £400 15s.; Crompton & Co., Ltd., £498. The last two tenders were received too late, and the contract was awarded to Messrs. Donnison, Sillem & Co., their tender being the lowest of those received in time.

Middlesbrough.—The E.L. Committee has accepted the tender of Callender's Cable Co. for certain mains extensions, at £2,733.

Radcliffe.—The Electricity Committee last week considered tenders for completion of machinery and foundations, &c., at the electricity works, and accepted several sub-tenders at a total estimate of £2,995 15s.

Roumania.—The Roumanian State Railway Authorities have just placed a contract for a quantity of electric cable, with Messrs. Felten & Guilleaume, of Mulheim-am-Ruhr.

St. Pancras.—The Guardians have accepted the tender of Messrs. Barlow Bros. & Co. (£1,094) for the wiring of the Highgate Infirmary for electric lighting at £1,094. There were seven lower tenders, but they did not comply with the specification,

Southampton. — The County B.C. has accepted the amended tender of the Alphons Custodis Chimney Construction Co. at £2,189, for the construction of the chimney shaft at the Electricity Works, on the Western Shore.

Willesden.—The D.C. has placed an order with the Tudor Accumulator Co. for additional plates, costing £685, to complete the storage battery at the electricity works.

FORTHCOMING EVENTS.

Monday, July 27th.—At 6 p.m. Annual meeting of the London Electrical Contractors' Association at Frascati's Restaurant, Oxford Street, W. [See "Notes" columns.]

NOTES.

Lowestoft Electric Tramways.—The opening of the Lowestoft Municipal tramway system took place on Wednesday, 22nd inst., and if the experience of other seaside resorts is repeated, the service should add a great deal to the admitted popularity of the town with its numerous visitors. A procession of five gaily decorated cars, the first being driven by the Mayor, traversed the various routes, and drew up at the Grand Hotel, where an inaugural luncheon given by the engineers and contractors was held. The Mayor, L. F. Orde, Esq., presided, and was supported by the town clerk and various civic representatives, Mr. W. C. C. Hawtayne, the consulting engineer, and Mr. Russell Colman and other gentlemen. Toasts of "The King," "The Engineers and Contractors," "The Corporation Tramways," and "The Press," were given and suitably acknowledged, the Mayor being the recipient of a silver presentation bowl at the hands of the engineers. Special reference was made to the good feeling existing between contractors, Corporation, railway company and consulting engineers, and to the excellent and rapid way in which the work has been carried out. A commencement was made on March 11th, 1903, and the work was practically completed by the end of June. The system consists of 5½ miles of route, partly double track, equipped on the trolley system. Power is obtained from the Corporation electricity works, in which extra generating plant has been installed for the purpose. There are 11 double and four single-deck cars, and a special track sweeper. The car-shed is situated close to the generating station, and contains four tracks with space for 15 cars. The line possesses one or two features of engineering interest. The swing bridge across the harbour in the centre of the town necessitated special overhead construction, and a somewhat complicated lay-out occurs where the tramways and railways cross at the entrance to the quays. It was also necessary to lay a cable under the harbour for the purpose of maintaining the rail circuit. The contractors for the permanent way were Messrs. George Wimpey and Co., London, the overhead equipment Messrs. R. W. Blackwell, the switchboard, cars and equipment by the British Westinghouse Co., and for the new generating machinery, the British Thomson-Houston Co.

Training of Engineers.—Principal A. P. Laurie, of the Heriot-Watt College at Edinburgh, writes to the *Times* placing on record the arrangements which have recently been made there with some of the leading engineering firms in Edinburgh, hoping that the information may be of use to others who are engaged in technical education:—"A few months ago a scheme was proposed to them by which the training of engineers might be improved by a combination of the course of instruction in the technical college with that of the workshop. The two main features of this scheme were that students should be allowed to commence their apprenticeship before they had completed their college course, and that the apprenticeship should be shortened for students who had obtained the college diploma. This proposal has been favourably received by several of our leading engineering firms in Edinburgh, with the result that they have agreed to take a limited number of students from the Heriot-Watt College into their works, in many cases at reduced premiums, allowing them to begin their apprenticeship at the end of their second winter session, and reducing their whole term of apprenticeship by one year. We are thus enabled to offer a complete course of training at the college for mechanical and electrical engineers, their whole training here and in the workshops taking from five to six years. When a student enters the college, he will at the same time be advised to enter his name as an apprentice with one of these firms, so that his apprenticeship will begin without fail at the end of his second winter session. I am sure this arrangement will prove of great benefit, as it will enable parents to arrange for the whole training of their sons as engineers without having, as is too often the case at present, to send them first to a technical college, and then search for a suitable firm in which to apprentice them."

Electrical Expert Required for Australia.—Sir Edward Barton, Premier of Australia, has written to Sir Wm. Preece asking him to aid the Government in the selection of an English electrical expert to systematise the electrical branches of the postal department in the various States. The new official will be appointed for a term of years at a salary of about £1,000 a year.

The Proposed New Technical Institute.—A joint committee of the General Purposes Committee and Technical Education Board of the London County Council presented to the Council on Tuesday a lengthy report in reference to the important proposal contained in Lord Rosebery's letter to the Chairman of the Council for the provision in London of public opportunities for advanced technological teaching and research. [The scheme was commented upon by us in our issue of July 3rd.] The Committee accordingly ask the Council to pass the following resolutions:—(*a*) That the Council expresses its high appreciation of the important proposal contained in Lord Rosebery's letter, and would cordially welcome the establishment of further provision in London for advanced technological teaching and research; (*b*) That the Council, in response to the request contained in Lord Rosebery's letter, places on record its opinion that, when the land, buildings, and equipment for the proposed additional technological teaching and research are provided to a value of not less than £500,000, the Council will be well advised to contribute, out of the moneys annually placed at its disposal under the Local Taxation (Customs and Excise) Act of 1890, a sum not exceeding £20,000 per annum towards such part of the work as falls within the statutory definition of technical education, subject to the following conditions:—(1) That a scheme be prepared to the satisfaction of the Council for the constitution of the governing body and the adequate representation of the Council thereon; (2) That financial arrangements adequate to the whole maintenance of the proposed work are made to the satisfaction of the Council; (3) That, in view of the national scope and utility of the proposed work, substantial contributions towards maintenance be made from funds of a national character; (4) That due provision be made in the scheme to prevent overlapping and secure co-ordination of the work already carried on by the University colleges, polytechnics, and other science and technological institutions, and the proper connection of the whole with the University; (5) That a sufficient number of scholarships, including free places, be placed at the disposal of the Council; (6) That it be considered whether other counties and boroughs should not be invited to contribute towards the maintenance, receiving in return the right to send their picked scholars for instruction under the proposed scheme.

South African Notes.—Our Johannesburg correspondent writes under date June 29th:—

Durban.—The Harbour electrical engineer strongly recommends the adoption of electricity for all harbour works, including hoisting, transporting and storing plant, and recommends the Advisory Council to specialise in each direction and so obtain the most efficient and economical type procurable. He also advises early extensions to the existing electric light and power station. The Durban County Electric Tramway Bill has passed the third reading.

Ladysmith.—The Ladysmith E.L. Bill has passed first reading.

Newcastle.—Tenders are invited for the installation of electric light in the streets and municipal buildings of Newcastle. The main street, Scott Street, will be lighted with 32-C.P. incandescent lamps, 16-C.P. lamps being used for the side streets, in all cases being placed 80 yds apart. 50 16-C.P. lamps are estimated for the Town Hall.

Cradock, O.R.C.—The Municipal Council is considering an offer from a private firm for the electric lighting of the town.

Pretoria.—The trams, which have been stopped since the war, will resume service in a few weeks.

Overhead Transmission Wires.—In the House of Commons on Monday, Mr. Markham asked the President of the Board of Trade whether, seeing that the Governments of America, France, Germany, Switzerland, Italy, and other countries have, during the last 10 years, passed laws regulating the methods of distributing high-tension current by overhead wires, which has resulted in a widely employed use of electricity for industrial purposes, he would say whether there was a single case in Great Britain or Ireland where high-tension current overhead wires had been installed. According to the *Times*, the following reply was made by Mr. Gerald Balfour:—"There is no case in Great Britain or Ireland where bare overhead wires have been installed for the transmission of electricity at high voltage for industrial purposes. The Department has not been asked to sanction this method of supply until quite recently, and, as I have already intimated, is ready to give favourable consideration to each application. I have no objection to asking the Foreign Office for copies of the laws of the countries named. A memorandum was sent in a covering letter addressed to the electrical adviser to the Board of Trade with a request that that officer would receive a deputation. The electrical adviser answered the memorandum himself, and the matter was properly within his cognisance. I have given my personal attention to this question of distributing high-tension current by overhead wires. As I have already informed the hon. member, the Board of Trade have been, and still are, prepared to consider each case on its merits without reference to any model regulations. In the cases now under consideration the electrical adviser will prepare special regulations applicable to the circumstances of each case. Model Regulation 33 does not appear to relate to aerial conductors. If the hon. member refers to Regulation 23, that is not a model regulation which would now be insisted upon in dealing with a high-tension system."

London Electrical Contractors' Association.—The annual general meeting of this Association is to be held at Frascati's, Oxford Street, at 6 p.m., on Monday next, July 27th. The annual report will be presented, the new president, vice-president, and other officers elected, and a resolution respecting the constitution of the Association will be proposed by Mr. W. R. Woodward, past-president.

Obituary.—Correction.—We fell into a awkward error last week when the name of Mr. Killingworth Richard Hedges caught our eye in the *Times* deaths column. With our insatiable thirst for news, we thought at once of the only Killingworth Hedges of whom we had ever heard, and began to regret the loss of one who had of recent years devoted himself so earnestly to the subject of lightning protection, and in years gone by had been so closely identified with electricity supply questions. We are pleased to learn that our regrets were quite misplaced, for Mr. Hedges has not severed his connection with us, and we trust that he may long be spared to render useful service in the branches of the electrical profession, in which he is a specialist. Our only excuse for falling into the error must be the striking similarity of uncommon names. Had it been William Brown or James Smith we might have read the announcement with greater reserve.

Since the above was in type, the following letter has come to hand:—

1, Emery Hill Street, Westminster, S.W.
July 22nd, 1903.

My attention has been directed to my obituary notice, which should have referred to my cousin, the late Mr. Killingworth Richard Hedges, a solicitor; and as some of your readers may imagine that I am the Mr. Hedges referred to, I write to ask if you will kindly insert as an explanation in the next number of the Electrical Review a paragraph to the effect that, although I am flattered at the reference to my pioneer work with regard to the introduction of the electric light, I am still here, and actively engaged as consulting engineer for several important central stations, in addition to the ever-increasing work of specifying for the protection of buildings from lightning; I am also engineering director of one of the London waterworks companies, so that my time is well occupied in the important question of the transfer to the new Water Board.

Killingworth Hedges, M.I.C.E.,
Hon. Sec. of the Lightning Research Committee.

We learn with regret of the death, which occurred on July 15th, of Mr. J. S. Stevens, of Poundfield, Old Woking, senior partner in the well known Battersea firm of Archibald Smith & Stevens. There will be no changes in connection with the business, which will be conducted as heretofore by the surviving partners.

The Trafford Park Fatality.—The inquest into the cause of the death of the man Clague, electric crane repairer, at the British Westinghouse works, was resumed on 20th inst., and Mr. G. S. Ram, Electrical Inspector of Factories, gave evidence. He said that on May 26th he inspected the Westinghouse works, and found a number of exposed switches all over the building. The company promised that these should be protected, but on visiting the works that day he found that the switch on the 50-ton crane, on which the deceased lost his life, was still uncovered. Some of the cranes had been protected, and he scarcely expected to find the whole of the work carried out in a short space of time.

The jury returned a verdict to the effect that the deceased met with an unnatural death, apparently caused by an electrical shock. The foreman said the jury were satisfied that death was accidental, but there was no satisfactory evidence as to how the shock was given.

Appointments Vacant.—Shift engineer for Buxton (30s.); instructor in mathematics (part time only) for Northampton Institute; clerk of works (£3) for the electric wiring of St. Pancras Infirmary; switchboard attendant for Swindon. See "Official Notices" to-day.

India and China Telegrams.—In the House of Commons last week an hon. member asked the Postmaster-General if he would use his best endeavours to obtain some alleviations of the cable charges between India and China commensurate with the reductions recently announced between the United Kingdom and China. Mr. Austen Chamberlain replied that he had communicated with the cable company concerned, but in view of the recent reductions to which the hon. member referred, and of others made by the company during the last few years, which had resulted in a diminished revenue, the company was unable to make any further reductions at present.

Callender's Buy Up the Anchor Cable Co.—The business of the Anchor Cable Co., of Leigh, has been disposed of as a going concern to Callender's Cable and Construction Co., Ltd., London. £6 5s. has been paid for the Anchor Co.'s £10 share. The works of the company are new, having been erected only three years ago.

A New Canal Project.—It is expected that in the next session of Parliament one or two Bills will be promoted with the object of obtaining power to construct a great ship canal from London, through Surrey and Hampshire, to Southampton. Two companies have been registered with this object, one the London and Southampton (Canal) Co., and the other the Inland Waterways Co. During the past two or three weeks a large number of local authorities in Surrey and Hampshire have received notices from the latter company of their intention to apply to Parliament for powers to supply electricity within their respective areas. It has been stated by a gentleman connected with one of the companies that the canal will be designed to permit of the passage of large vessels. It will be 64 miles in length, 80 ft. wide, and 12 ft. or more in depth. At its southern extremity it will connect with Southampton Docks, and it will make a junction, probably a few miles above Teddington, with the Thames. There will be a number of locks on the canal, all operated by electricity, and an electric tramway will, it is stated, be constructed the whole length of the canal, with powerful motors for haulage purposes.

Personal.—Mr. Arnold G. Hansard, consulting electrical engineer, has removed his office from 92, Victoria Street, S.W., to 53, Victoria Street, S.W.

An American exchange says that Mr. E. B. Schattner, of London, of electricity meter fame, is to join the staff of the General Electric Co. at Schenectady, that company having acquired the American rights for his meter.

Mr. Leon Gaster, consulting electrical engineer, announces that his address is now 32, Victoria Street, S.W.

Royal Commission on Trade Disputes.—A preliminary meeting of this Royal Commission was held at the House of Commons last Friday afternoon.

Fire.—Fusion of electric wires caused a fire which destroyed many valuables in a temporary supper tent at Grosvenor Square. A concert party arranged by Mrs. Lionel Phillips had, as a result, to be abandoned.

Will.—Mr. David Davy, of Sheffield, head of the firm of Davy Bros., engineers and boiler makers, who died on April 19th last, has left estate of the gross value of £208,795, the net personalty being £195,311.

THE CENTRAL STATION ENGINEER.

The Bradford Corporation has postponed advertising for an electrical engineer to take the place of Mr. Chattock, who has been appointed to Birmingham. It is intended to consider the question of amalgamating the Electricity Committee and the Tramways Committee.

Out of over 100 applicants, Mr. J. F. Schoolbred, chief assistant at the Stockport Corporation Electricity Works, has been appointed clerk of the works in connection with the Newcastle-under-Lyme municipal electric light works.

At the meeting of the Lighting and Electricity Committee on Monday last, 20th inst., Mr. J. Gray Scott, the borough electrical engineer, was presented with a marble timepiece by the Committee on the occasion of his approaching marriage.

More than 100 applicants put in for the post of assistant electrical engineer at Llandudno, rendered vacant by the appointment of Mr. Allen to take charge of Messrs. Harland & Wolff's power and electric light plant at Belfast. The E.L. Committee has since appointed Mr. L. H. Tylecote.

NEW COMPANIES REGISTERED.

Glamorgan Engineering Co., Ltd. (77,939).—This company was registered on July 6th, with a capital of £16,000 in £1 shares, to acquire and carry on the business of electrical and mechanical engineers (but not of metal merchants, machinery brokers and licensed valuers) carried on by C. E. and H. M. Peel, Ltd., at Swansea, and elsewhere, and to adopt an agreement with the said company, C. E. Peel, H. M. Peel, and A. L. Furneaux. The first subscribers (each with one share) are:—C. E. Peel, Quay Parade, Swansea; H. M. Peel, Quay Parade, Swansea, iron merchant; A. L. Furneaux, 35, Banbury Road, Oxford, electrical engineer; W. Jones, 6, Stanley Terrace, Swansea, accountant; C. W. Jordan, Bryn Coed, Lonlas, Llansamlet, R.S.O., engineer; C. Smart, 13, Carlton Terrace, Swansea, engineer; and C. G. Peel, Lonlas, Neath, apprentice engineer. No initial public issue. The number of directors is not to be less than three nor more than five; the first are C. E. Peel, H. M. Peel, and A. L. Furneaux; remuneration as fixed by the company. Registered office, Glamorgan Engineering Works, Upper Strand, Swansea.

Ozone Generators, Ltd. (77,942).—This company was registered on July 6th, with a capital of £6,000 in £1 shares, to adopt a contract between E. Coustau and H. Diamont, and to carry on the business of manufacturers and sellers of a gas generally described as "ozone," either by means of an electrical apparatus or otherwise. The first subscribers (each with one share) are:—W. C. Meaby, 14, St. Paul's Road, Canonbury, N., clerk; D. N. Button, 42, Wellwood Road, Goodmayes, Ilford, typist; W. V. G. Ditchfield, 31A, Prairie Street, Queen's Road, Battersea, clerk; R. Yewin, 108, Crownfield Road, Stratford, E., clerk; C. F. Burden, 121, Elderfield Road, Clapton, N.E., clerk; H. Diamont, 20, Bucklersbury, E.C., M.D. (Strassburg); and A. F. Harris, 95, Leadenhall Street, E.C., surveyor. No initial public issue. The first directors are S. H. Albright, W. Ligby, and H. Diamont; qualification, £5; remuneration, £50 each per annum. Registered office, 29-30, King Street, Cheapside, E.C.

British Tramways and General Construction Co., Ltd. (78,034).—This company was registered on July 16th, with a capital of £300,000 in £1 shares, to carry on the business of financiers, concessionnaires, commission agents, bankers, contractors for public or private works, capitalists, company promoters, owners and workers of railways, tramways, electric light, traction and power works, gas and water works and means of transport, constructors of electric tramways or light railways, wires, cables, dynamos, motors, engines, rolling stock, and the like, electricians, mechanical engineers, omnibus and van proprietors, carriers of passengers and goods, suppliers of electricity, &c. The first subscribers are:—O. H. Smith, 83, Cannon Street, E.C., manufacturer, 100 shares; H. C. Lewis, 83, Cannon Street, E.C., director, 100 shares; J. Gray, 58, Comeragh Road, West Kensington, W., patent agent, 1 share; F. R. Davenport, B6, Albany, Piccadilly, W., 1 share; C. Ebel, 345, Queen's Road, Battersea, S.W., clerk, 1 share; J. E. Gibbons, 4, Georgette Place, Greenwich, S.E., shorthand writer, 1 share; and E. R. G. Abbot, 84, Mysore Road, Clapham Common, S.W., accountant, 1 share. No initial public issue. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, £100; remuneration, £200 each per annum (£50 extra for the chairman).

Ulster Electric Power Distribution Co., Ltd. (2,775).—This company was registered in Dublin on July 9th with a capital of £10,000 in £1 shares, to produce and supply electrical energy and power for public and private lighting. The first subscribers (each with 100 shares) are: A. M. Kirker, Craigavad, Co. Down, chairman Irish Distillery, Ltd.; J. Sinclair, Belfast, linen manufacturer; P. O'Mahony, Grangeton, Co. Wicklow; R. J. McMordie, Cabin Hill, Belfast; W. H. Preece, 8, Queen Anne's Gate, K.C.B.; P. E. Beachcroft, 10, Upper Hamilton Terrace, London, N., director; T. E. F. Hodgson, St. Mary's Abbey, Bedford, gentleman; J. B. Martin, Members Mansions, Westminster, S.W., land owner; A. C. C. de Renzy, 20, Park Hill, Ealing, K.C.B.; and S. L. Macroy, Limavady, Co. Derry, director of Donegal Railway Co. The number of committee is not to be less than four nor more than seven; the subscribers are to appoint the first; remuneration as fixed by the company. Registered office: 1, Lombard Street, Belfast.

Automatic Circuit Breakers, Ltd. (78,059).—This company was registered on July 18th, with a capital of £100 in £1 shares, to acquire and take over the rights and obligations of H. J. Swirles, H. Swanton and R. Starke, under an agreement between the said H. Swanton and R. Starke, and to carry on the business of electrical and general engineers, manufacturers of, agents for and dealers in circuit breakers, tools, dynamos, engines, electrical appliances, cycles, motors, carriages, cables, wires, lamps, switchboards, accumulators and the like, &c. The subscribers are:—H. J. Swirles, 63, Penrose Street, Walworth, S.E., mechanical engineer, 2 shares; H. Swanton, 63, Whitehouse Street, Stepney, E., engineer, 2 shares; R. Starke, 195, Upper Thames Street, E.C., merchant, 2 shares; W. P. Warren, 525, Holloway Road, N., engineer, 1 share; R. A. Starke, 53, Ravensdale Road, N., traveller, 1 share; A. B. Starke, 195, Upper Thames Street, E.C., wholesale druggist, 1 share; and D. Gibbon, 59, Grove Road, St. John's Wood, N.W., salesman, 1 share. No initial public issue. The number of directors is not to be less than two nor more than six; the first are H. Swanton, R. Starke and H. J. Swirles (managing directors); qualification, £10.

Lionel Robinson & Co., Ltd. (78,015.)—This company was registered on July 14th, with a capital of £50,000 in £1 shares, to acquire the business carried on at 9, Carteret Street, Westminster, and at Salem Road, Bayswater, as "Lionel Robinson & Co.," to adopt agreements (1) with L. I. Robinson and R. G. W. Ellis; (2) with the said L. I. Robinson; and (3) with the said R. G. W. Ellis, and to carry on the business of electrical engineers and contractors, electricians, manufacturers of and dealers in all apparatus and things capable of being used in connection with the generation, distribution, supply, regulation, accumulation and employment of electricity, mechanical engineers, boiler makers, iron, brass and metal founders, launch and ship builders, machinists, fitters, millwrights, tube makers, wire drawers, iron and steel converters, metallurgists, toolmakers, &c. The first subscribers are:—L. I. Robinson, 9, Carteret Street, Westminster, S.W., electrical engineer, 500 shares; R. G. W. Ellis, 9, Carteret Street, Westminster, S.W., electrical engineer, 500 shares; W. G. Adams, F.R.S., 43, Campden Hill Square, W., 1 share; C. M. Billington, Blomfield House, London Wall, E.C., civil and electrical engineer, 500 shares; C. W. Atkinson, 2, Queen Anne's Gate, S.W., civil engineer, 500 shares; H. E. Knight, 37, Lyncroft Gardens, Hampstead, N.W., clerk, 1 share; and W. Russell, 2, Wardrobe Place, Doctor's Commons, E.C., solicitor, 1 share. No initial public issue. The number of directors is not to be less than two nor more than seven: the first are L. I. Robinson and R. G. W. Ellis (managing directors); qualification, £500; remuneration of ordinary directors, when number does not exceed four, £600 per annum, div., and £150 per annum for each additional director. The original managing directors are to receive, in addition to their share of above, £600 per annum, div., when the paid-up capital is less than £21,000, with an extra £15 for each completed £1,000 in excess of £20,000, and also 15 per cent. of the surplus profits remaining, after providing for a dividend of 10 per cent on the paid-up ordinary capital, divisible.

Reliance Electric Co., Ltd. (78,054).—This company was registered on July 17th, with a capital of £1,000 in £1 shares, to carry on the business of electrical and mechanical engineers, electricians, suppliers of electricity for light, heat, power or otherwise, manufacturers of and dealers in electric, magnetic, telegraphic, telephonic and other appliances and apparatus, &c. The first subscribers (each with one share) are:—R. J. Urquhart, Gardner Road, West Derby, Liverpool, consulting engineer; S. Pearce, 46A, Market Street, Manchester, manufacturing chemist; E. J. Hill, 46, Deansgate, Manchester, merchant tailor; R. G. Macleod, 25, Acomb Street, Manchester, traveller; J. L. Rawbon, 2, Downing Street, Ardwick, Manchester, artist; G. O. Caine, 238, Deansgate, Manchester, licensed victualler; and E. W. Bundy, 4, Albert Place, Dickinson Road, Longsight, Manchester, accountant. No initial public issue. The number of directors is not to be less than two nor more than five; the first are G. Smith and W. P. Theermann; qualification, 25 shares. Registered office, 265, Deansgate, Manchester.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Globe Telegraph and Trust Co., Ltd. (7,465).—This company's annual return was filed on June 9th, when 180,877 preference and 180,877 ordinary shares had been taken up out of a nominal capital of £5,000,000 in 250,000 preference and 250,000 ordinary shares of £10 each. 45,009 shares are issued subject to payment wholly in cash, and £433,115 5s. has been received. £3,167,450 is considered as paid on 316,745 shares. Mortgages and charges: *nil*.

West India and Panama Telegraph Co., Ltd. (11,116).—This company's annual return was filed on June 9th, when 88,321 ordinary, 34,563 first preference and 4,669 second preference shares had been taken up out of a nominal capital of £2,445,630 in 200,000 ordinary, 34,563 first preference and 10,000 second preference shares of £10 each. £1,275,530 is considered as paid. Mortgages and charges: £80,000.

W. H. Allen, Son & Co., Ltd., electrical and mechanical engineers, Bedford (66,640).—Issue on June 19th of £900 second debentures, part of a series created June 15th, 1903, to secure £40,000, charged on the company's undertaking and present property (subject to £40,000 first mortgage debentures). Trustees: Law Guarantee and Trust Society, Ltd., 49, Chancery Lane, W.C. Previously issued of same series, £24,100.

Peterborough Electric Traction Co., Ltd. (74,562).—A trust deed dated June 26th, 1903, to secure £20,000 debenture stock has been registered. Property charged: all the company's assets, present and future. Trustees: Electric and General Investment Co., Ltd.

CITY NOTES.

Chili Telephone Co., Ltd.

Mr. Geo. Keith presided on Thursday last week at Winchester House, E.C., over the ordinary general meeting of the above company.

In moving the adoption of the report, the Chairman said that for several years the business of the company had been making steady progress and profits had been increasing, and he thought they would agree that the report showed a good record for the past year. The gross revenue had increased by about 11 per cent., while the total expenditure worked out at 47¾ per cent. of the revenue, which was about the same as in the previous year. The higher exchange which had ruled during the year had also contributed to the sterling profits. The income from Chili amounted to £28,723, and that from dividends, discounts and transfer fees made a total of £29,328, while there remained a net profit of £23,367, after the deduction of the London expenses, debenture interest, and income-tax. This was as compared with £19,040 in the previous year. With the amount brought forward they had an available balance of £26,100, out of which they proposed to place £11,088 to reserve,

pay a dividend of 6 per cent., and carry forward £2,637. The reserve now stood at £49,000, and the investments at £25,000. The result was satisfactory, for the payment of a 6 per cent. dividend realised the expectations of the business when the company was started. Since they commenced operations Chili had passed through difficult times, but the settlement with Argentine had brought about a favourable reaction, and the financial situation had since considerably improved. Exchange had been moving up and now stood at 16⅞ths, while commerce was more active and the business prospects far better. There was no doubt that people of Chili appreciated the advantages of the telephone, and the company's lines were being gradually extended through the country. During the past year 451 miles of new wire was put up. Last year he told them that it was the intention to place their lines underground in the central parts of Santiago, but the work for the present was postponed, owing to the proposed law of regulating electric services not having yet passed Congress. It was expected, however, that the newly elected municipality would take the matter up in the interests of the City. In conclusion, the Chairman said the whole of the company's plant was in an efficient condition, and the service was being well maintained, and they could look forward to the continued prosperity of the company.

The Hon. W. G. ALLSOPP seconded the motion, and the report was adopted.

City & South London Railway Co.

THE directors' report for the half-year ending June 30th, 1903, to be submitted to the half-yearly meeting on Tuesday next, 28th inst., reads as follows:—"The receipts from all sources for the past half-year have amounted to £81,770 7s. 5d., and the cost of working has been £37,919 3s. 3d., leaving a profit of £43,851 4s. 2d. Inclusive of the balance brought forward from December 31st last, the net revenue account shows an aggregate total of £45,379 2s. After making provision for the debenture stock interest, and the transfer to the renewal fund of £1,500, a balance remains available for dividend of £33,006 9s. 11d. Out of this sum the directors recommend that the full dividend of 5 per cent. per annum be paid on the preference stocks, 1891, 1896 and 1901, and that a dividend at the rate of 2½ per cent. per annum be paid upon the consolidated ordinary stock for the half-year, leaving a balance of £1,500 0s. 11d. to be carried forward to the next account. The following table shows the number of passengers, exclusive of season ticket holders, carried since the opening of the railway, and dividends paid in each half-year:—

Half-year.	Number of passengers (exclusive of season ticket holders).	Receipts (including season tickets).	Dividend per cent. per annum on ordinary stock.
		£ s. d.	
Ended December 31st, 1890 (11 days)	165,000	1,568 3 9	Nil.
,, June 30th, 1891	2,412,343	19,403 6 9	,,
,, December 31st, 1891	2,749,055	19,798 16 6	,,
,, June 30th, 1892	2,813,162	20,931 4 2	½
,, December 31st, 1892	3,117,602	22,002 17 5	½
,, June 30th, 1893	3,146,656	22,458 6 9	½
,, December 31st, 1893	3,093,351	22,067 14 10	½
,, June 30th, 1894	3,3-3,154	23,564 10 6	1
,, December 31st, 1894	3,275,649	23,540 12 4	1½
,, June 30th, 1895	3,113,199	23,711 5 8	1½
,, December 31st, 1895	3,172,438	23,780 8 7	1½
,, June 30th, 1896	3,192,672	24,021 13 0	1½
,, December 31st, 1896	3,368,480	25,456 6 9	1½
,, June 30th, 1897	3,437,810	26,408 3 6	2
,, December 31st, 1897	3,337,861	25,472 12 10	1½
,, June 30th, 1898	3,478,977	26,356 16 4	2½
,, December 31st, 1898	3,462,814	26,319 14 10	2
,, June 30th, 1899	3,540,098	26 749 3 0	2½
,, December 31st, 1899	3,442,942	26,197 14 10	1½
,, June 30th, 1900	4,169,717	33,608 2 3	1½
,, December 31st, 1900	5,018,842	44,716 3 11	1½
,, June 30th, 1901	5,887,786	51,013 17 3	1½
,, December 31st, 1901	7,008,842	59,734 14 8	2½
,, June 30th, 1902	9,192,120	76,*43 12 3	3
,, December 31st, 1902	9,877,199	82,131 7 1	3½
,, June 30th, 1903	9,511,150	78,384 19 9	2½
Total since the opening of the line ..	108,369,219	£856,237 4 6	—

Railway opened for traffic December 18th, 1890.
Extension to Moorgate opened February 25th, 1900.
Extension to Clapham Common opened June 3rd, 1900.
Extension to Islington opened November 17th, 1901.

The directors regret that although the receipts of the line show a small increase over those of the corresponding period of last year, some addition to the expenses, together with a larger amount of interest payable on the debenture and preference stocks, have necessitated a decrease of ¼ per cent. in the dividend. The natural increase of the traffic has been interfered with by the competition of the electric tramways, which are run by the London County Council at very low fares, and especially during the fine weather draw away many passengers from the railway. It is hoped, however, that this will prove only of temporary duration and that the traffic will gradually return. The appeal in respect to the compensation to be paid for the site of the station under St. Mary Woolnoth Church having been decided against the company, an order was made that the whole amount awarded should be paid into Court together with the accumulated interest, amounting in the whole to £89,904 4s. 3d. (in addition to £81,350 already paid into Court) and this has been done, the necessary funds having been raised by the issue of preference and debenture stocks. The questions involved being of such great importance to the company, the directors propose to carry the case to the House of Lords, where they hope they may obtain a more favourable decision. The Bill for the extension to King's Cross, St. Pancras and Euston, including also the transfer of the undertaking of the City and Brixton Railway to this company, has been passed by the committee of both Houses of Parliament, and will, it is expected, shortly receive the Royal assent. Feeling that the extension to King's Cross, St. Pancras and Euston is of the greatest importance to the company, and likely to result in a large accession of traffic, the directors recommend that the construction of this line should be proceeded with at once, and they will ask the proprietors' sanction to the creation and raising of the necessary capital. As the Bill authorises the payment of interest out of capital during construction, it is not anticipated that there will be any charges upon the revenues of the company until the line is finished and open for traffic. The works of the Great Northern and City Railway are approaching completion, and it is hoped that the line will be ready for traffic before the end of the present year."

Prospectuses.

THE list was to close yesterday in an issue of £200,000 5 per cent. first mortgage debenture stock in the *Auckland Electric Tramways Co., Ltd.* The share capital is £300,000 all paid up. The undertaking is a B.E.T. concern, and the Electric and General Investment Co. are trustees for the debenture stock holders. 14¾ miles of double-track line are in operation, and a further two miles will be completed shortly. The object of the present issue is principally to repay borrowed money.

The *Manchester and Liverpool Electric Express Railway Co.* is before the investing public this week, the list closing to-day, with an issue of £2,100,000 in 210,000 £10 shares—the whole of the nominal capital. The objects of the scheme are pretty well known to readers of the ELECTRICAL REVIEW, involving the adoption of the Behr electric mono-rail system between the two places mentioned. The line will be 34 miles 3 furlongs in length, and its cost, according to the latest estimates, will be £2,298,515 (including £1,400,000 for works, £558,515 for lands, and £340,000 for the generating station and electrical equipment). The authorised debenture powers are £700,000, so it will be seen that there remains, on the estimate, a balance of £501,485 for finance, administration, contingencies, and payment of 3 per cent. interest upon share capital during construction. This latter item of interest is limited in the aggregate to £150,000. If the capital were fully paid up, this would allow interest over a period of 2½ years, or thereabouts, but only £1 per share has to be paid on application, £1 per share on allotment, and the balance when called for. The 3 per cent. payments may thus be considered assured for longer than the 2½ years, according to the dates of the subsequent share calls. Messrs. R. Elliott Cooper, M.I.C.E., and F. B. Behr, of Westminster, are the engineers, and Lord Kelvin and Sir W. H. Preece are consulting engineers for the electrical work. Accompanying the prospectus there are circulated a few extracts from the evidence given in favour of the scheme before the Parliamentary Committee; also the proceedings of the local committee, and a reprint of a description of the Behr system which appeared at the end of last year in a contemporary.

Direct United States Cable Co.

THE directors' report for the six months ended June 30th, to be presented at the meeting to be held at Winchester House, on Tuesday, 28th inst., at two o'clock p.m., says:—

The half-year's revenue, after deducting out-payments, amounted to £48,886 12s. 7d. as compared with £46,610 6s. 11d. for the corresponding period of 1902, showing a difference of £2,276 5s. 8d. in favour of the half-year under review. The working and other expenses for the same period, including income-tax, amounted to £21,724 0s. 7d., leaving a balance of £27,162 12s. as the net profit, making with £4,779 13s. 6d. brought forward from the previous half-year a total of £31,942 5s. 6d. For the corresponding period of 1902, the working expenses and other payments amounted to £21,515 17s. 1d. Three quarterly interim dividends of 3s. each per share, amounting to £27,819 10s. have been declared, and paid during the financial year, and a final dividend of 3s. per share is now proposed, together with a bonus of 1s. per share, making with the three interim dividends, 8½ per cent. for the year, being a total distribution of £39,461 10s. After transferring £8,000 to the reserve fund account, the balance of £2,693 15s. 6d. on the revenue account is proposed to be carried forward. The reserve fund account has been debited with £22,931 13s. 11d. for cost of cable repairs, and after being credited with interest on the investments, profit on sale of securities and amount transferred from revenue, the balance now amounts to £474,664 16s. 1d., taking the investments at cost price. The interests of the company were represented at the International Telegraphic Congress which sat in London from May 26th to the 8th inst.

Edmundson's Electricity Corporation.

THE report for the year ended March 31st last, to be presented at the meeting on the 23rd inst., states that, including the sum of £6,179 brought forward from last year, the net profit, after payment of debenture interest, amounts to £53,048. After deducting dividends on preference shares paid and accrued, amounting to £9,540, and an interim dividend at the rate of 5 per cent. per annum on the ordinary shares, there remains a balance of £37,257. The directors recommend a final dividend on the ordinary shares at the rate of 9 per cent. per annum, making 7 per cent. for the year, to be written off goodwill account £5,000, and added to reserve fund £9 274, leaving to be carried forward £11,733. During the year 20,000 preference shares and £40,000 debenture stock have been issued. The premiums received in respect of these issues, less expenses, amount to £16,725, and have been added to the reserve fund, which, with the contribution proposed to be made from revenue account, will be increased to £40,000. The 4,500 deferred shares have been converted into ordinary shares, in accordance with the articles of association.

The General Electric Co. (1900).

The directors' report, to be submitted at the meeting to be held at 71, Queen Victoria Street to-day, at 12 o'clock noon, reads:—

"The directors beg to submit to the shareholders their annual report, together with the audited accounts to March 31st, 1903.

The net trading profits and income from investments, &c., amount to	£94,381	14	4			
Less loss at Witton Works	20,001	11	7			
	74,380	2	9			
After deducting depreciation and debenture interest amounting to	22,349	0	7			
There remains a balance of ..				£52,031	2	2
Out of which the dividend on the preference shares at the rate of 5 per cent. for the year ended March 31st, 1903, has been paid, absorbing				12,500	0	0
Leaving an available balance of ..				£39,531	2	2
Which the directors recommend should be appropriated as follows:—						
To payment of managing directors' and employés' bonus	£3,953	2	2			
To payment of dividend on ordinary shares at the rate of 5 per cent. for the year ended March 31st, 1903	14,419	0	0			
To reserve account	21,159	0	0			
				£39,531	2	2
The Reserve Account—						
The reserve account stands in the accounts at being the amount of undivided profits as at March 31st, 1902	£39,051	2	0			
The proposed appropriation of the undivided profit of the year ended March 31st, 1903, amounts to	21,159	0	0			
Giving a total of reserve account of				£60,210	2	0

"The trading profit derived from the general business of the company has shown an increase in almost every department, and the net result must be considered satisfactory. On the other hand, the establishment of the new works at Witton, involving the teaching and training of new workpeople, and entailing expenses inseparable from the creation of a new industry in this country, has occasioned a loss during the first year's working. The directors have thought it prudent to write off the whole of such loss this year; nevertheless they have, by reducing the dividend on the ordinary shares, still been able to place an amount to reserve that is up to the standard of previous years. The engineering works at Witton are now well provided with orders, and there are indications that they will add materially to the profits of the company in the coming year. During the year further 2,422 ordinary shares have been allotted to the directors of the company and members of the staff at par. Mr. T. Hawkins retires by rotation from the position of director. The auditors, being eligible, offer themselves for re-election."

An extraordinary general meeting is to be held at 12.30, or as soon afterwards as the ordinary general meeting of the company, when the subjoined resolution will be proposed:—"That the name of the company be changed to the General Electric Co., Ltd."

Anglo-American Telegraph Co.—The directors have resolved, after placing £6,000 to the credit of the renewal fund, to declare an interim dividend for the quarter ending June 30th, 1903, of 15s. per cent. on the ordinary stock and £1 10s. per cent. on the preferred stock. There is then a balance of about £1,468 to be carried forward to the next account.

Eastern Telegraph Co.—The accounts show, after payment of the interim dividend of £1 5s. per cent. on the ordinary stock to December 31st, a balance available sufficient to pay a final dividend of £1 5s. per cent. and a bonus of £2 per cent., both free of tax, on the ordinary stock, payable on the 30th inst., making a total distribution of 7 per cent. for the year ended March 31st.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following securities to be quoted in the Official List:—British Electric Traction Co, Ltd.—Further issue of 75,000 6 per cent. cumulative preference shares of £10 each, fully paid.

STOCKS AND SHARES.

Wednesday Evening.

Here and there business in the Stock Exchange is by no means as bad as is frequently the case during the dog days, but trade is remarkably "spotty," as the House colloquially calls it. Speculation is entirely confined to the American railroad market, while what small amount of investment business there still remains is almost confined to the Home Railway department in the usual track of what may be termed popular investment areas. Already some of the Stock Exchange pillars support controversial literature upon the Free Trade and Protection questions, and members are driven to discuss politics in default of stocks and shares.

One of the chief features of the past week is the substantial improvement that has taken place in telegraph issues. In our last issue attention was directed to the gradual lifting of the cloud of suspicion which has for so long hung over this market by reason of the wireless wonders. But our persistent contention that the Marconi and similar systems can hardly enter the arena of practical competition for years to come is at length fixing itself in the minds of those who hastened to sell in sheer nervousness. By the steady payment of their accustomed dividends, and by the patent facts revealed by their accounts that they are still able to maintain their position, the telegraph companies have borne in upon the erstwhile proprietors a suggestion that they, the shareholders, might, after all, have been a little premature in parting with sound investments at low prices, in many cases at a severe loss. It is now sought to replace the stocks sacrificed, while there is also a steady demand from financial corporations and other capitalists, large and small, for the investments, well secured, and paying a good rate of interest. The market seems to have touched bottom, and therefore the buyer is actively to the front.

The price lists on the following page show that nearly two dozen stocks and shares in the telegraph market are harder, and the highest rise has been secured by the Submarine Cable Trust certificates, which are 4 points to the good. This, of course, does not mean much to the British investor, and the price is simply moved from New York; even to deal in the stock one has to go to the American and not the Telegraph market. Several stocks have added 2 per cent, amongst them being Eastern Ordinary (which is still cum dividend) and West Coast of America Debentures. Eastern Extensions are a particularly good market at 12¼. The Anglo-American trio shows a triple improvement on the better dividend announcement; but Commercial Cable stock is unaltered, although the 4 per cent. Debenture has followed up its rise of last week with another advance. Directs also improved upon the good report. All the West India and Panama series are decidedly better the opinion being expressed that investors see attraction in the high yields to be obtained from the Preference shares in this company. Western Telegraphs have jumped up a sovereign. Cuba Preference and West African shares both exhibit another rise of 10s. each, making £1 in the fortnight. There are none too many shares about in the Telegraph market, and buying orders are sometimes difficult to execute even at the outside price of the two quoted. An advance in Globe Telegraphs reflects the better feeling of the market as a whole.

Telephone varieties have been over-shaded by the activity in Telegraphs, but National Third Preference climbed ⅛ on the appearance of the company's report, and United River Plate Preference recovered the fraction that they shed last week.

After the animation amongst the cable shares, the Electrical Supply section shows up tamely so far as fluctuations in prices are concerned. Indeed, the only noticeable changes consist of a drop of ½ in City of London Ordinary, and of ¼ in Chelsea shares, there being still quiet pressure to sell. It is significant of this market that the new Metropolitan Preference shares which were difficult to sell at sixpence premium soon after their issue are now quoted at 2s. 6d premium and upwards, nor is a further advance improbable in view of the fact that very similar shares in this list stand considerably higher. No change occurred in General Electric Preferences upon the issue of the report, which document explains most satisfactorily the apparent paradox of a heavy reduction in the Ordinary dividend, coupled with increased trading profits. There are plenty of worse 5 per cent. investments than General Electric Preference shares.

None of the Home Railway dividends so far declared have done much to arouse enthusiasm in this section. The City and South London report shows how increased expenditure has swamped better earnings, and the price of the stock shows a further decline of five points. Central Londons keep up, the dividend being 4 per cent. as anticipated, but Waterloo and City is down a trifle. Mersey Ordinary sticks at 16, and the mono-rail prospectus met with a more cordial reception academically than financially. That is to say, there is general agreement as to the very interesting character of the scheme propounded, but whether it will be a great monetary success for some years to come is called in question. The South Lancashire Electric Tramways Co., by the way, boasts that when its new lines are completed, it will have the longest electric car route in the country. The Metropolitan Railway dividend is distinctly good, but the price of the stock is dull at 88½.

In the traction market, British Electric Ordinary have slipped back ¼, and this department is quiet on the whole. Cape Electrics changed hands at 2 7/16 on Tuesday, and Calcuttas at 7 on the same day. The new Auckland Electric Debentures are nominally about par. A few miscellaneous changes call for mention, British Aluminium Debenture having gone up 2; the stock is scarce, and there are prospective purchasers about. The price of the 6 per cent. "A" Preference shares is 6 middle. Callender's Preference are ¼ easier, and the revival in telegraph issues has not made any difference to the manufacturing companies up to the present.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations July 15th.	Closing Quotations July 22nd.	Business done week ended July 22nd, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅛— 3⅛	2⅛— 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	61s.	60/6	47 — 50	48 — 51	..	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	92 — 94	93 — 95	94	93½
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	8¼— 8⅝	8⅜— 9	8⅝	8 15/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	6 %	4⅜— 5⅛	4⅜— 5⅛	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	150 —160	150 —160	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	91 — 94	92 — 95	93½	92½
16,000	Cuba Telegraph	10	4½%	4 %	6½%	6½— 7⅛	6⅜— 7⅛	..	..
6,000	Do. 10 % Pref.	10	..	..	..	16 — 17	15⅝— 16⅝	16⅝	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2⅜— 3⅛	2⅜— 3⅛	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
30,000	Do. do. 4½ % Debs.	50	..	..	..	97 —101	97 —101	..	..
60,710£	Direct United States Cable	20	3¼%	3¼%	3¼%	10 — 10½	10½— 10⅝	10½	10⅛
87,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	126 —131	128 —133	131	128½
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	88 — 91	89 — 92	91	89½
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	107	106½
900,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	10½— 11½	12 — 12½ xd	12⅝	11⅞
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	106 —109	108	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	101 —104 %	99 —102	101⅜	100
180,227	Globe Telegraph and Trust	10	5⅛%	5⅛%	..	8¼— 9	9 — 9½	9⅛	8⅞
180,042	Do. do. 6 % Pref.	10	..	..	..	12⅝— 13¼	13 — 13⅝	13⅝	12⅞
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	22 — 23	22 — 23	..	..
62,500£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101 xd	98 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	35 — 39	35 — 39	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —104	100 —104	100⅝	..
1,933,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	102 —104	102 —104	104	103½
1,966,667	Do. do. Def. Stock	100	..	..	4½%	82 — 84	82 — 84	83	82⅝
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12½— 13½	12⅝— 13½	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5¼	5⅝— 5⅞	5 13/16	..
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96½— 98	96 — 98	97½	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	102½—103	101 —103	102⅝	101½
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	1 1/16— 1 1/8	1 1/16— 1 1/8	1 1/16	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,839	Reuter's	8	5 %	5 %	..	6½— 7½	6½— 7½	..	..
3,303	Submarine Cables Trust	Cert.	..	..	..	112 —117	113 —118	..	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	5½— 6 xd	5½— 6 xd	6	5⅞
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4½— 5	4½— 5¼	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	103 —106	104 —107	..	..
15,609	West African Telegraph, Shares	10	..	..	2 %	4½— 5½	5 — 6	5½	5¼
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	93 — 96	95 — 98	..	..
267,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	..	11⅞— 11¼	12 — 12¼	12 1/16	11⅞
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	97 —100	97 —100	..	..
88,321	West India and Panama Telegraph	10	1½%	..	..	⅜— ½	⅜— ⅝	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6 — 6½	6½— 7	6 7/16	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3 — 4	4 — 5	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	97 —100	98 —101	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
800,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	75 — 80	77 — 82	..	..
100,000	British Electric Traction	10	9 %	9 %	8 %	12 — 12⅝ xd	11¾— 12¼ xd	12¼	11 3/16
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	11¾— 12¼	11¾— 12¼	12⅛	11⅝
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	122 —125	122 —125	124¼	124¼
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6¾— 7⅛	6¾— 7⅛	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅝— 6	5⅝— 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —106	102 —106	104½	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	1/6— 1/8	1/6— 1/8	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	¾— 1⅛	¾— 1⅛	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1⅛— 1⅜	1⅛— 1⅜	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	87 — 92	87 — 92	..	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	11⅛— 12⅛	11⅛— 12⅛	11⅝	11⅛
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5¼— 6	5⅛— 5⅞	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	106 —110	106 —110	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	104 —107	104 —107	105½	105
494,093	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	101 —104	101 —104	103½	103
494,993	Do. do. Def. do.	Stock	..	4 %	4 %	107 —110	107 —110	108⅛	..
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	68 — 70	63 — 65	68	64
85,000	Crompton & Co., Nos. 1 to 85,000	8	8 %	7½%	..	2 — 2½	2 — 2½	2 5/16	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	101 —105	101 —105	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 — ⅛	0 — ⅛	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	2 1/16— 2⅛	1⅞— 2⅛	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	71 — 75	71 — 75	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	75 — 80	75 — 80	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅛— 1⅜	1⅛— 1⅜ xd	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2⅛— 3 xd	2⅛— 3 xd	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	99 —102 xd	99 —102 xd	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	9½— 10	9½— 10	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	99 —102	99 —102	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	14 — 15	14 — 15	14⅞	14
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5⅛	5 — 5⅛	5⅛	5 1/16
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	108 —112	108 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½— 19½	18½— 19½	18⅝	..
800,000£	Do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	5⅜— 5⅞	5⅜— 5⅞	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10½— 11	10½— 11	..	..
37,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	32 — 35 xd	32 — 35 xd	34¾	34
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1939	100	..	..	..	100 —103	100 —103	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3⅛%	98 —101	97 —100	98	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

National Electric Free Wiring, ⅜—⅝.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14¼—14⅞.
Do. do. Pref. (£10 pd.), 10—10⅛.

Bank rate of discount 3 per cent. (June 18, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations July 15th.	Closing Quotations July 22nd.	Business done week ended July 22nd, 1903. Highest.	Lowest.
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	‡ £1	..	..	..	⅞— ⅞	⅞— ⅞	15/16	⅞
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	..	..	..	118 —121	118 —121	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	6 %	8 %	8 %	10¾— 11	10¾— 11	10	10
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10¾— 10⅞	10¾— 10⅞	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9¼	9 — 9¼	9⅛	9⅛
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	6¼— 6	5¾— 6	5 11/16	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4¾— 5	4¾— 5	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	104 —106	104 —106	106	..
44,436	*Chelsea Electricity Supply, Ord.	5	5½%	4 %	4½%	6 — 6¼	5¾— 6¼	..	..
150,000£	Do. do. % Deb. Stock Red.	Stock	..	..	..	107 —110	107 —110	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	11¼— 12 xd	11 — 12½ xd	11⅞	11 3/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13 — 14 xd	13 — 14 xd	13 5/16	13
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	121 —126	121 —126	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	104½	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	4 %	8 — 9	8 — 9	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11¼— 12½	11½— 12½	12⅛	..
400,000£	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red ..	..	..	..	..	109 —112	109 —112	..	..
50,000	Edmundson's Electricity Corporation, Ord. Shares	5	7 %	7 %	7 %	6½— 7	6½— 7	..	..
30,000	Do. do. 6 % Cum. Pref.	10	..	..	..	6 — 6¼	6 — 6¼	..	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	106 —109 xd	106 —109 xd	..	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	11 — 12	11 — 12	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	103 —106	103 —106	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	2 — 2½	2 — 2½	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5½— 6	5½— 6	..	..
250,000£	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	100 —103	100 —102	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6¼%	7½%	17½— 18½	17½— 18½	18 1/16	17 11/16
220,000£	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	108 —112	108 —112	..	..
250,000£	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	97 —100	97 —100	97	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	13 — 14	13 — 14	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15¾— 16½	15¾— 16½	..	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8½— 9½	..	..
150,000£	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	98 —101	98 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3½— 4	3 — 3½	3⅜	..
65,000	South London Electricity Supply, Ord.	5	..	..	1½%	3¾— 4	3¾— 4	..	..
30,000	Urban Electric Supply, Ord.	5	..	..	..	5 — 5¼	5 — 5¼	5 3/16	..
30,000	Do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5¼	5 — 5¼	5 1/16	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12 — 13	12 — 13	12 9/16	12 1/16
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6¼— 6¾	6¼— 6¾	6⅝	6¼

*Subject to Founders Shares. ‡Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, July 22nd.

CHEMICALS, &c.

			Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	32/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ...	per ton	£30	..
a	Bleaching powder	per ton	£4 10	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£13	..
a	Benzole (90%)	per gal.	7/-	..
a	,, (50/90%)	per gal.	5/6	..
a	Copper Sulphate	per ton	£19	..
a	Lead, Nitrate	per ton	£34	..
a	,, White Sugar	per ton	£31	..
a	,, Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a	Potash, Bichromate, in casks ..	per lb.	3d.	..
a	,, Caustic (75/80%) ..	per ton	£24	..
a	,, Bisulphate	per ton	£35	..
a	Shellac	per cwt.	136/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 5	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70%) ..	per ton	£10 15	..
a	,, Crystals	per ton	£8	..
a	,, Bichromate, casks.. ..	per lb.	2¼d.	..

METALS, &c.

b	Aluminium Ingots, in ton lots ..	per ton	£130	..
b	,, Wire, in ton lots ..	per ton	£168	..
b	,, Sheet, in ton lots ..	per ton	£166	..
p	Babbitt's metal ingots	per ton	£43 to £145	..
c	Brass (rolled metal 2" to 12") basis	per lb.	7d.	½d. dec.
c	,, Tube (brazed)	per lb.	8¾d.	½d. dec.
c	,, ,, (solid drawn).. ..	per lb.	7½d.	..
c	,, Wire, basis..	per lb.	7½d.	½d. dec.
c	Copper Tubes (brazed)	per lb.	9d.	..
c	,, ,, (solid drawn) ..	per lb.	9¼d.	..
g	Copper Bars (best selected ..	per ton	£71	..

METALS, &c. (*continued*).

			Latest Price.	Week's Inc. or Dec.
g	Copper Sheet	per ton	£71	..
g	,, Rod	per ton	£71	..
e	,, (Electrolytic) Bars ..	per ton	£65	£2 dec.
e	,, ,, Sheets ..	per ton	£76	£2 dec.
e	,, ,, Rod	per ton	£67	£2 dec.
e	,, ,, H.C. Wire	per lb.	7¾d.	¼d. dec.
f	Ebonite Rod	per lb.	3/8	..
f	,, Sheet	per lb.	3/-	..
h	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	8/-	..
h	India-rubber, Para fine	per lb.	4/- to 4/0½	..
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	46/8½	6½d. inc.
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£11 15	..
g	,, ,, Sheet	per ton	£13	10/- dec.
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£8 12 6	..
d	Mica (in original cases) small ..	per lb.	4d. to 1/2	..
d	,, ,, ,, medium	per lb.	2/8 to 3/6	..
d	,, ,, ,, large ..	per lb.	3/9 to 7/9	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p	,, rolled bars & rods	per lb.	1/1 to 1/4	..
p	,, ,, strip & sheet	per lb.	From 1/2	..
o	Platinum	per oz.	£4	..
p	Silicium Bronze Wire	per lb.	10d. to 1/-	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£126¾ to £127	inc.
g	,, Foil	per lb.	1/8	..
n	,, Wire, Nos. 1 to 16	per lb.	1/7	..
p	White Anti-friction Metals—			
	"White Ant" brand ..	per ton	£42 to £65	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7¾d.	..
j	,, 6 lea. Flax	per lb.	6⅝d.	..
j	,, 3 ply 10 lbs. Russian ..	per lb.	4 13/16d.	..
j	,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j	,, 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£23 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakespeare; *h* Edward Tull & Co.; *i* Bolling & Lowe; *j* W. H. Hindley & Co. *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
	Aberdeen	June 27	1,247	— 48	4,864	+ 915	—	—
	Birmingham	July 18	5,183	+173	—	—	—	—
	Bournemouth	,, 15	1,105	—	—	—	—	—
	Blackburn	June 26	909	—286	11,668	+ 674	12½	+1½
	Blackpool	July 16	1,363	—166	3,680	+ 1,089	—	—
	Blackpool and Fleetwood	,, 18	1,125	— 54	2,445	+ 95	7½	—
	Bolton	,, 19	1,931	+316	30,253	+ 4,142	25	—
	Bradford	,, 19	3,954	—356	60,075	+ 9,237	39	+2
	Brighton	,, 19	982	+ 73	27,853	—	6½	—
	Bristol	,, 17	5,376	+111	—	—	28	—
	Burnley	,, 18	935	+144	—	—	—	—
British Elec. Trac. Co.	Barnsley District ..	,, 10	179	—	4,818	—	—	—
	Devonport	,, 10	507	+ 6	11,658	+ 347	5	—
	Dudley—Stourbridge..	,, 10	884	+115	21,618	+ 2,240	18½	—
	Gateshead	,, 10	863	+ 67	23,109	+ 3,988	10½	+ ½
	Gravesend—Northfleet	,, 10	310	—	5,935	—	3½	—
	Greenock—Pt. Glasgow	,, 10	640	+ 66	13,969	+ 1,251	7½	—
	Hartlepool	,, 10	334	+ 17	6,875	+ 446	6½	+2
	Kidderminster	,, 10	155	+ 8	3,319	+ 185	4½	—
	Merthyr	,, 10	236	+ 22	5,292	— 247	8	—
	Middleton	,, 10	193	+ 83	8,446	+ 830	8½	—
	Oldham—Ashton ..	,, 10	591	+ 20	15,388	+ 1,416	8	—
	Peterborough	,, 10	297	—	3,690	—	—	—
	Poole	,, 10	857	+ 65	7,572	+ 1,287	8½	—
	Potteries	,, 10	1,467	— 19	42,072	+ 2,547	28½	—
	Rothesay..	,, 10	303	+118	2,710	+ 975	—	—
	Sheerness	,, 8	91	—	1,241	—	—	—
	Southport	,, 10	378	+ 90	7,804	+ 1,685	6½	—
	South Staffordshire ..	July 10	974	+181	22,696	+ 1,588	21½	—½
	Swansea	,, 10	545	+ 82	13,113	+ 625	5½	—
	Taunton	,, 10	63	— 2	1,527	— 118	1½	+1½
	Tynemouth	,, 10	414	+ 25	7,685	+ 904	8½	—
B.E.T. Co.	Weston-super-Mare..	,, 8	204	— 4	2,051	— 293	2½	+2½
	Wolverhampton Dist.	,, 10	434	+273	10,461	+ 6,030	10½	+8
	Wrexham	,, 10	128	—	2,046	—	—	—
	Yorks. Woollen Dist..	,, 10	372	—	5,911	—	6	—
	Cardiff	,, 18	2,061	+438	31,056	+11,154	—	—
	Dover	,, 18	265	— 2	5,973	+ 123	3	—
	Dublin	,, 17	5,258	— 68	13,046	+ 331	46	—
	East Ham	,, 18	719	+193	10,755	+ 3,431	6	+ ½
	Glasgow	,, 18	13,556	+1434	96,529	+12,175	65	+19
	Hull	,, 18	1,874	+ 57	28,897	+ 1,651	11	+ 1
	Ilkeston	,, 15	207	—	—	—	—	—
	Isle of Thanet	,, 18	1,279	— 27	14,220	— 323	—	—
	Leeds	,, 18	5,709	+179	90,375	+ 5,634	—	—
	Liverpool	,, 11	10,602	+ 195	275,050	+10,557	101	+2½
	Manchester	,, 18	12,069	+6471	—	—	110	+86
	Newcastle	,, 18	3,283	+491	—	—	17	—
	Portsmouth	,, 18	2,201	+176	—	—	29	—
	Salford	,, 13	4,149	+1413	55,278	+14,152	—	—
	Southampton	,, 9	1,122	+ 31	—	—	—	—
	Sunderland	,, 20	1,222	+130	19,350	+ 592	20	+ 2
	Central London Railway	,, 18	6,548	+218	20,260	— 113	6	—
	Chatham & District Co.	,, 9	662	+198	13,205	+11,458	8½	—
	City and S. London Ry.	,, 19	2,490	— 79	7,418	— 758	6½	—
	Dublin and Lucan Elec. Rlwy.	,, 19	126	— 6	345	— 27	—	—
	Liverpool Overhead Ry.	,, 19	1,742	+109	5,183	+ 390	4½	—

* Compared with the corresponding period of 1902.

MODERN VIEWS ON MATTER: THE REALISATION OF A DREAM.

By Sir WILLIAM CROOKES, F.R.S., &c.

An Address delivered before the Congress of Applied Chemistry at Berlin, June 5th, 1903.

(*Concluded from page* 116.)

Let me briefly recount some of the properties of radium, and show how it reduces speculations and dreams, apparently impossible of proof, to a concrete form.

Radium is a metal of the calcium, strontium, and barium group. Its atomic weight, according to C. Runge and J. Precht, is probably about 258.

The spectrum of radium has several well-defined lines; these I have photographed and have also measured their wave-lengths. Two, especially, are strong and characteristic. One, at wave-length, 3,649·71, and the other, at wave-length, 3,814·58. These lines enable radium to be detected spectroscopically.

The emanations cause soda-glass to assume a violet colour, and they produce many chemical changes. Their physiological action is strong, a few milligrammes brought near the skin in a few hours producing a wound difficult to heal.

The most striking property of radium is its power to pour out torrents of emanations bearing a certain resemblance to Röntgen rays, but differing in important points.

The emanations from radium are of three kinds. One set is the same as the cathode stream, now identified with free electrons—atoms of electricity projected into space apart from gross matter—identical with "matter in the fourth or ultra-gaseous state," Kelvin's "satellites," Thomson's "corpuscles," or "particles;" Lodge's "disembodied ionic charges, retaining individuality and identity." These electrons are neither ether-waves nor a form of energy, but substances possessing inertia (probably electric). Liberated electrons are exceedingly penetrating. They will discharge an electroscope when the radium is 10 ft. or more away, and will affect a photographic plate through five or six mm. of lead and several inches of wood or aluminium. They are not readily filtered out by cotton-wool; they do not behave as a gas, *i.e.*, they have not properties dependent on inter-collisions, mean free path, &c.; they act more like a fog or mist, are mobile and carried about by a current of air to which they give temporary conducting powers, clinging to positively electrified bodies and thereby losing mobility, and diffusing on the walls of the containing vessel if left quiet.

Electrons are deviable in a magnetic field. They are shot from radium with a velocity of about one-tenth that of light, but are gradually obstructed by collisions with air atoms, so that some become much slowed, and then are what I formerly called loose and erratic particles, which diffuse about in the air, and give it temporary conducting powers. These can turn corners, can be concentrated by mica cones into a bundle and then produce phosphorescence.

Another set of emanations from radium are not affected by an ordinarily powerful magnetic field, and are incapable even of passing through thin material obstructions. These emanations have about one thousand times the energy of those radiated by the deflectable particles. They render air a conductor and act strongly on a photographic plate. Their mass is enormous in comparison with that of the electrons, and their velocity is probably as great when they leave the radium, but, in consequence of their greater mass, they are less deflected by the magnet, are easily obstructed by obstacles, and are sooner brought to rest by collisions with air atoms. The Hon. R. B. Strutt* was the first to affirm that these non-deflectable rays are the positive ions moving in a stream from the radio-active body.

Rutherford has shown that these emanations are slightly affected in a very powerful magnetic field, but in an opposite direction to the negative electrons. They are therefore proved to be positively charged bodies moving with great velocity. For the first time Rutherford has measured their speed and mass, and he shows they are ions of matter moving with a speed of the order of that of light.

There is also a third kind of emanation produced by radium. Besides the highly penetrating rays deflected by a magnet, there are very penetrating rays not at all affected by magnetism. These accompany the previous emanations, and are Röntgen rays—ether vibrations—produced as secondary phenomena by the sudden arrest of velocity of the electrons by solid matter, producing a series of Stokesian "pulses" or explosive ether waves shot into space.

Many lines of argument and research tending towards the same point give trustworthy data by which to calculate the masses and velocities of these different particles. I must deal with big figures, but big and little are relative, and are only of importance in relation to the limitations of our senses. I will take as the standard the atom of hydrogen gas—the smallest material body hitherto recognised. The mass of an electron is $\frac{1}{700}$th of an atom of hydrogen, or 3×10^{-26} grm., according to J. J. Thomson, and its velocity is 2×10^{9} centimetres per second, or two-thirds that of light. The kinetic energy per milligramme is 10^{17} ergs, about $3\frac{1}{2}$ million foot-tons. Becquerel has calculated that 1 square centimetre of radio-active surface would radiate into space 1 gramme of matter in 1 billion years.

* *Phil. Trans. R. S.*, A., 1901, Vol. cxcvi., p. 525.

The positively electrified masses or ions are enormously great in comparison with the size of the electron. Sir Oliver Lodge illustrates it thus:—If we imagine an ordinary sized church to be an atom of hydrogen, the electrons constituting it will be represented by about 700 grains of sand each the size of an ordinary full-stop (350 positive and 350 negative) dashing in all directions inside, or, according to Lord Kelvin, rotating with inconceivable velocity. Put in another way; the sun's diameter is about $1\frac{1}{2}$ million kilometres, and that of the smallest planetoid about 24 kilometres. If an atom of hydrogen be magnified to the size of the sun, an electron will be about two-thirds the diameter of the planetoid.

The extreme minuteness and sparseness of the electrons in the atom account for their penetration. While the more massive ions are stopped by inter-collisions in passing among atoms, so that they are almost completely arrested by the thinnest sheet of matter, electrons will pass almost unobstructed through ordinary opaque bodies.

The action of these emanations on phosphorescent screens is different. The electrons strongly affect a screen of barium platino-cyanide, but only slightly one of Sidot's zinc sulphide. On the other hand, the heavy, massive, non-deflectable positive ions affect the zinc sulphide screen strongly, and the barium platino-cyanide screen in a much less degree.

Both Röntgen rays and electrons act on a photographic plate and produce images of metal and other substances enclosed in wood and leather, and throw shadows of bodies on a barium platino-cyanide screen. Electrons are much less penetrating than Röntgen rays, and will not, for instance, show easily the bones of the hand. A photograph of a closed case of instruments is taken by radium emanations in three days, and by Röntgen rays in three minutes. The resemblance between the two pictures is slight, and the differences great.

The power with which radium emanations are endowed of discharging electrified bodies is due to the ionisation of the gas through which they pass. This can be effected in many other ways; thus, ionisation is communicated to gases faintly by the splashing of water, by flames and red-hot bodies, by ultra-violet light falling on negatively electrified metals, and strongly by the passage of Röntgen rays.

According to Sir Oliver Lodge's electronic theory of matter, a chemical atom or ion has a few extra negative electrons in addition to the ordinary neutral atom, and if these negative electrons are removed it thereby becomes positively charged. The free electron portion of the atom is small in comparison with the main bulk, in the proportion in hydrogen of about 1 to 700. The negative charge consists of super-added or unbalanced electrons—one, two, three, &c., according to the chemical valency of the body, whereas the main bulk of the atom consists of paired groups, equal positive and negative. As soon as the excess electrons are removed, the rest of the atom, or ion, acts a massive positively charged body, hanging tightly together. In a high vacuum the induction spark tears the components of a rarefied gas apart; the positively charged ions, having great comparative density, are soon slowed down by collisions, while the electrons are driven from the negative pole with an enormous velocity depending on the initial electromotive force and the pressure of gas inside the tube, but approaching, at the highest exhaustions, half that of light.

It is recognised that electrons have the one property which has been regarded as inseparable from matter—nay, almost impossible to separate from our conception of matter—I mean inertia. Now, in that remarkable paper of J. J. Thomson's, published in 1881, he developed the idea of electric inertia (self-induction) as in reality due to a moving charge. The electron, therefore, appears only as apparent mass by reason of its electro-dynamic properties, and if we consider all forms of matter to be merely congeries of electrons, the inertia of matter would be explained without any material basis. On this view, the electron would be the "protyle" of 1886, whose different groupings cause the Genesis of the Elements.

There is one more property of the emanations of radium to bring before your notice. I have shown that the electrons produce phosphorescence of a sensitive screen of barium platino-cyanide, and the positive ions of radium produce phosphorescence of a screen of zinc blende.

If a few minute grains of radium salt fall on the zinc sulphide screen, the surface is immediately dotted with brilliant specks of green light. In a dark room, under a microscope with a $\frac{2}{3}$-in. objective each luminous spot shows a dull centre surrounded by a diffused luminous halo. Outside the halo, the dark surface of the screen scintillates with sparks of light. No two flashes succeed on the same spot, but they are scattered over the surface, coming and going instantaneously, no movement of translation being seen.

If a solid piece of a radium salt is brought near the screen, and the surface examined with a pocket lens magnifying about 20 diameters, scintillating spots are sparsely scattered over the surface. Bringing the radium nearer the screen, the scintillations become more numerous and brighter, until, when close together, the flashes follow so quickly that the surface looks like a turbulent luminous sea. When the scintillating points are few, there is no visible residual phosphorescence, and the successive sparks appear "atoms of intensest light," like stars on a black sky. What to the naked eye seems like a uniform "milky way," under the lens, becomes a multitude of stellar points flashing over the whole surface.

In a vacuum the scintillations are as bright as in air, and, being due to inter-atomic motion, they are not affected by extremes of low temperature; in liquid hydrogen they are as brilliant as at the ordinary temperature.

A convenient way to show these scintillations is to fit the blende screen at the end of a brass tube with a speck of radium salt in front

about a millimetre off, and to have a lens at the other end. I propose to call this little instrument the "Spinthariscope," from the Greek word σπινθαρίς,* a scintillation.

It is probable that in these phenomena we actually witness the bombardment of the screen by the positive ions hurled off by radium with a velocity of the order of that of light. Each particle is rendered apparent only by the enormous extent of lateral disturbance produced by its impact on the sensitive surface, just as individual drops of rain falling on a still pool are not seen as such, but by reason of the splash they make on impact, and the ripples and waves they produce in ever-widening circles.

Indulging in a "scientific use of the imagination," and pushing the hypothesis of the electronic constitution of matter to what I consider its logical limit, we may be, in fact, witnessing a spontaneous dissociation of radium—and we begin to doubt the permanent stability of matter. The chemical atom may be actually suffering a katabolic transformation, but at so slow a rate that, supposing a million atoms fly off every second, it would take a century for weight to diminish by one milligramme.

It must never be forgotten that theories are only useful so long as they admit of the harmonious correlation of facts into a reasonable system. Directly a fact refuses to be pigeon-holed, and will not be explained on theoretic grounds, the theory must go, or it must be revised to admit the new fact. The nineteenth century saw the birth of new views of atoms, electricity and ether. Our views to-day of the constitution of matter may appear satisfactory to us, but how will it be at the close of the twentieth century? Are we not incessantly learning the lesson that our researches have only a provisional value? A hundred years hence, shall we acquiesce in the resolution of the material universe into a swarm of rushing electrons?

This fatal quality of atomic dissociation appears to be universal, and operates whenever we brush a piece of glass with silk; it works in the sunshine and raindrops, and in the lightnings and flame; it prevails in the waterfall and the stormy sea. And although the whole range of human experience is all too short to afford a parallax whereby the date of the extinction of matter can be calculated, Protyle, the "formless mist," once again may reign supreme, and the hour hand of eternity will have completed one revolution.

* Ἔνδ' ἐχ νηὸς δρουσεν ἄναξ ἐχάεργος Ἀπόλλων,
ἀστέρι εἰδόμενος, μέσῳ ἠματι τοῦ δ' ἀπὸ πολλαὶ
σπινθαρίδες πωτῶντο, σέλας δ' εἰς οὐρανὸν ἶχεν'.

(Here from the ship leaped the far-darting Apollo, like a star at midday, while rom him flitted scintillations of fire, and the brilliancy reached to heaven).
Homer's *Hymn to Apollo*, lines 440—442.

MUNICIPAL TRAMWAYS ASSOCIATION.

The annual conference of the Municipal Tramways Association of Great Britain was held at Glasgow, on July 8th, 9th and 10th, under the chairmanship of the president, Mr. John Young, general manager of the Glasgow Corporation Electrical Tramways.

There was an attendance of about 70 members of the Association. The meetings were held in the Council Hall of the municipal buildings in George Square. The conference assembled on the morning of July 8th, and the members were welcomed to Glasgow by Lord Provost Sir John Ure Primrose, Bart., who was accompanied by the majority of the members of the Corporation Tramways Committee. In the course of some remarks the Lord Provost said that he understood that the Association was founded about a year ago with between 60 and 70 municipalities in its membership. Its object was for conference in which experience would be exchanged and information given. It was not a close corporation; it was in the very best sense a confederation for mutual benefit and help among municipalities involved in the work.

Councillor Paton, convener of the Tramways Committee, remarked that before the Association was formed the various municipalities of the country had acted together in any object they wished to accomplish, and when they wanted to bring pressure upon the Government departments. They had generally got what they wanted, through the unity which existed amongst municipalities.

The business of the conference was then proceeded with, the chairman delivering a presidential address. He was pleased to state that almost all the corporations eligible had joined the Association, and had sent the chairman, or deputy-chairman, of their respective tramway committees to represent them at the conference. The membership was now 93, and they might fairly enough describe themselves as an association of municipal tramway experts and specialists. Although they were a municipal tramways association, they recognised that most of the questions and problems they should have to consider and discuss would apply to all tramways, whether operated by municipal corporations or by companies, and to tramway practice generally. They had, therefore, taken the liberty of inviting the Street Railway Association and the Street Railway Accountants' Association, of America, the Union Internationale de Tramways, and the Tramways and Light Railways Association, to send representatives to the conference. They were delighted to see some of these associations represented. Proceeding, Mr. Young remarked that the present age was unprecedented in history for new inventions and new industries. Electricity was responsible for most of these. The most important of them had to do with the inter-communication between people and places the whole world over, and with the transportation of passengers in and around our great centres of population. The electric tramway, or street railway, already occupied a very important place, and yet seemed to be only in its infancy. According to the latest returns for the United States, the length of line had increased in 12 years from 8,123 miles to 22,589 miles of single track, and of these 21,920 were electric lines. In this country, although we were slower than America or the Continent in adopting electric traction, progress had been very rapid during the past few years. He supposed we had now about 2,000 miles of electric tramways, while four or five years ago there were only a few miles.

Mr. J. Dalrymple, accountant Glasgow Tramways, afterwards presented a report on the standardisation of tramway accounts, which produced a very lengthy and, at times, noisy discussion. At the close Mr. A. Baker, chief officer of the London County Tramways, submitted a paper on the hours of labour, &c., of tramway employés.

After luncheon, an interesting discussion followed a report compiled by the President on permanent way construction and maintenance. A summary of the report was presented by Mr. Charles King, C.E., Glasgow.

The President, in the course of the discussion, remarked that in Glasgow they used 60-ft. rails, and they found no difficulty in handling them. He thought that the chemical composition of the rails required more consideration than it had hitherto received. His conclusion was, that ·56 or ·57 of carbon was the most satisfactory rail. As regards joints, they were going to make extensive tests in the autumn on thermit and electric welding. Their gauge was 4 ft. 7⅞ in. On the Govan side of the city the rails were laid down so that they could be used by railway wagons, and this had formed the standard. One hundred tons on four wheels, proceeded Mr. Young, was not uncommon in Glasgow. Those loads knocked about the track in a most unmerciful way, and he thought the loads should be restricted to a certain wheel which should be of a certain breadth.

Mr. Holliday, of Brighton, remarked that tramway construction had been having his attention for something like 25 years, so that he knew a little about it. In constructing electric lines, he had always found the weakest spot was the rail joints. He had tried many means in order to get over this difficulty. At Brighton he had made a new departure from what he had seen in this country. By the introduction of a sleeper or eye beam under each rail joint, and running transversely to and bolted to the rail, they got a form of anchor, because the whole weight of the concrete body was put on the joint. He had been watching this carefully, and had not found a defective joint. With regard to length of rail, he had always been against using a rail which was too long on account of the liability of buckling by men who were not careful in handling them. He advocated the adoption of a standard gauge. The only objection he could see to the 4 ft. 8½ in. gauge was, that it seemed to fit ordinary vehicular traffic very well.

Other members joined in the discussion.

In the evening the members of the conference were entertained to a complimentary dinner by the Lord Provost and Corporation of Glasgow. The function took place in the Banquetting Hall of the City Chambers. Lord Provost Primrose, Bart., presided, and amongst those at his Lordship's table were Mr. John Young, Councillor Paton, and Sir James Bell, Bart., Glasgow; Councillor Smithson, Leeds; Councillor Baker, London; Alderman Groine, Blackpool. The company numbered over 200.

After the loyal and patriotic toasts had been honoured, Councillor J. Allen Baker, of the London County Council, proposed the "Corporation of Glasgow." In London, he said, they looked upon Glasgow as their municipal Mecca, and he believed that feeling was shared by many other corporations as well. With regard to tramways, he thought it was no small task to have been pioneers in a great enterprise of that kind. Many municipalities had followed Glasgow's example, and now no fewer than 118 of them worked their own tramways.

The Lord Provost, in reply, said that the municipalisation of the tramways was the outcome of a body of men in the Council who, after full deliberation, came to the conclusion that a service which monopolised the streets and lay at the very elemental foundation of comfortable progress through the city should be controlled and conducted by the governing body.

Sir James Bell, Bart., in proposing the "Municipal Tramways Association," remarked that he had the honour of occupying the post of Lord Provost of the city at the time when the tramways were taken over by the Corporation, and he very naturally rejoiced at the enormous success which had followed that step. As a result of the tramways development under municipal management, they saw houses rising on the outskirts of the city, thereby relieving the congestion in the city, and bringing down the death rate.

Mr. John Young, replying, said that he did not think the Association had accomplished all they could have wished during their first year; but, if they had made only a fair start, they should be well satisfied. He thought they might fairly make that claim. They had already broadened their constitution, and developed a more comprehensive title and a wider and more influential membership.

The conference resumed the following morning. At the business meeting the vice-president (Mr. C. R. Bellamy), general manager of the Liverpool Corporation Tramways, was elected president for the ensuing year, and Mr. Alfred Baker, chief officer of the London County Council Tramways, vice-president. Six new members were elected to the Executive Committee, as follows:—Councillor Paton, Glasgow; Councillor Boyle, Manchester; and Councillor Smithson, Leeds, as representing Corporations; and Mr. C. J. Spencer, Bradford; Mr. H. England, Sunderland; and Mr. P. Fisher, Dundee, as representing tramway managers. The conference for 1904 was arranged to be held at Liverpool.

Afterwards Mr. C. J. Spencer, Bradford, in place of Mr. C. R. Bellamy, Liverpool, read a paper in which he gave a comparison of the tramway conditions in America and Great Britain.

The paper by Mr. L. Mackinnon, traffic superintendent of the Glasgow Tramways, on "The Selection and Training of Motormen and Conductors," was taken as read.

In the afternoon the members of the conference visited the Pinkston power station of the city tramways, and in the evening the Association dinner was held.

The conference was brought to a conclusion on the Friday by an excursion on the turbine steamer *King Edward* to Inverary.

THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

The Sunderland Convention.

Saturday, the 18th inst., witnessed the winding up of the eighth annual Convention of the Municipal Electrical Association. With an attendance greater than on previous occasions (due, it was whispered, to the dismal weather which prevailed during practically the whole of the time), the gathering promised to be more interesting than its predecessors. Unfortunately, in this we were disappointed, as the discussions were, on the whole, uninteresting, both from an engineering and commercial point of view. Controversial papers were contributed by Aldermen Smith and Pearson. Mr. Le Rossignol described his own power station, and appended an interesting table of costs. Mr. Boot detailed his unfortunate experience with water-tube boilers (or possibly it would be more correct to blame the water). Dr. Panton contributed a useful paper on the very important subject of stimulating demand, and Mr. Jeckell described the methods he had adopted for lifting his town, Coventry, out of the mire. As to the visits, Sunderland on early-closing day in a downpour of rain is not a cheerful prospect, even when supplemented by a Corporation banquet, and many stragglers sought the excitement of the Sunderland Railway Station in preference to visits on "special" cars.

Thursday's gathering was welcomed by the chairman of the local gas company, a feature which was duly appreciated. From him we gathered that Newcastle was more advanced municipally than we had previously supposed it to be. In the afternoon, in a pouring rain, the visitors boarded more special cars and proceeded to view the Corporation's great achievement—also partaking of light refreshments, on the invitation of the Corporation, and subsequently paying further visits to local establishments in special cars, specially remarkable from the fact that no one appeared to be aware of their destination. The evening found us studying a musical programme, presumably arranged by a local refreshment contractor.

Middlesbrough was the meeting-place on Friday, and the discussion on Alderman Pearson's paper on "The Sphere of Utility of a Power Company" was taken there, having been left over from the previous day. After the consideration of the other papers set down in the day's programme, visits were paid to the Middlesbrough electricity works, the Middlesbrough, Stockton and Thornaby electric trolley system, and other places of interest.

Below we give abstracts of some of the papers, together with some comments of our own thereon, and the discussions which occurred at the convention.

ELECTRIC TRACTION AS APPLIED TO THE NEWCASTLE TRAMWAYS.

By A. E. Le Rossignol.

This paper deals with a special case of a power station site, and is not a traction paper at all.

The peculiarity of the site allotted for the station is that it was a piece of made ground about 80 ft. above the river. The chimney had to be founded on a concrete block formed over the head of piles driven down, it was believed, to an old roadway buried below. The concrete formed a block 30 ft. × 30 ft. × 15 ft. thick.

The foundations of the other buildings also required special treatment, and were simply steel interlaced concrete blocks, which floated, so to speak, on the made-up earth. Indeed, where some of the original hard earth was found, it was cut away so as not to allow the blocks of concrete to go aground, the excavation being filled in soft to secure as equal conditions all over the foundation area as possible.

The station is of such size as to contain eight Lancashire boilers, 30 ft. × 8 ft. 6 in., and an economiser of 480 pipes, and there are coal bunkers specially arranged to deliver the coal that has longest been in store, in order to avoid risk of spontaneous combustion.

The generator sets are of 400, 635, 635, and 1,300 kw., and a set of 3,000 kw. is being added, and there is a 1,500 ampere-hour battery.

To secure condensing water there are two high-lift centrifugal pumps, which force water through a 24-in. pipe to the station. These pumps are driven by turbines fed by the return water from the condensers through another 24-in. main. The turbines provide about half the power required, the balance being provided by electric motors on the common spindle of the turbine and pump. The author adds a table of costs, based on seven million units per annum, including interest, labour, materials, management, and capital charges, generally to show how the attempt has succeeded which he has made to get over the difficulties of the site.

Mr Rossignol's paper, which we abstract above, suggests at least that the construction of the Newcastle power station must have been a work of interest. The station site appears to have had one merit. It was electrically central. For the rest it was apparently Hobson's choice, and had no water for condensing, being 80 ft. above the river, and a ¼ mile distant. Moreover, the ground was so nearly all made up that to prevent accident the original solid hillside where it was encountered, was cut away and filled in soft so as to allow the concrete foundation blocks of the various station buildings to "float" freely on the made earth right across the narrow valley. The chimney alone was carried down by piles to the surface of an old stone paved road buried below.

The chief interest turns on the supply of condensing water. After compelling the returning hot waste to do half the work of pumping up the cold water from the river to the power station, the other half had to be helped up by electric power. It is assumed that the centrifugal pump and the turbine had an average efficiency of 70 per cent., and that in the cycle the efficiency was, therefore, 50 per cent. Assuming that the pump, therefore, had an efficiency of 70 per cent., and the motor one of 80 per cent., and that the condensing water was thirtyfold the feed water, and that each H.P.-hour required 24 lbs. of steam, we can calculate the foot-pounds of work to be done in lifting the half of the water 80 ft. high. It amounts to fully 1·5 H.P.-minutes for each H.P.-hour, or 2·5 per cent. of the station H.P. Even if we double this figure to 5 per cent. there should still remain a large balance in favour of condensing, which may save 20 to 25 per cent. of the steam in a traction station. But one may still suggest whether all this water-lifting might not have been avoided by carrying a large exhaust pipe from the engines to the riverside instead of sending the river up-hill to bring the heat down.

Theoretically, an exhaust pipe can be made air-tight, and with careful work even one a quarter of a mile long can be put together tight. There need not be very great loss if the pipe be fairly straight. There is a prevalent idea that steam will not flow down-hill, but this overlooks the fact that the containing vessel is closed from the atmosphere and there is a vacuum vessel at the lower end.

It seems probable that where there is a water supply within such reach that water can be sent up and on to a station, steam can more easily be sent down to the water. We are told that the selected arrangement demanded a pair of 24-in. pipes, which would therefore occupy as much ground as one 4-ft. exhaust pipe of double the area.

No figures are given either of the number of cars or of the station output, from which can be calculated the output of exhaust steam, but it is tolerably certain that the cost of the two water mains would have more than covered the cost of the exhaust steam main, that the condenser placed at the river, if not in it, would have cost less than that on the hill, the air-pump would have been less, and a mere propeller as circulating pump would have consumed a fraction of the electric energy consumed by the present pumps. It would be interesting to know if anything beyond hide-bound precedent determined upon the scheme to pump hundreds of tons of water up hill to bring down a few imponderable heat units.

The condensed steam from the surface condenser would so easily and economically have been carried up hill in a pipe laid inside the large exhaust pipe. It seems that the same results could have been secured with very much less capital expenditure. We are not told if the 24-in. water mains are or could have been exposed on the surface, but if they could have been what a fine opportunity was missed of a cheap surface condenser 400 yds. long.

The energy and labour to run the pumping station alone cost over 2 per cent. of the total cost per unit. The return of the condensed steam would not require more than about one-twentieth the energy swallowed by the centrifugal pump, if so much. Altogether a good opportunity seems to have been missed of showing what a convenience it is to drive machinery at a distance by electricity, and of proving that a tight exhaust pipe is possible.

In the short discussion which followed the paper, Messrs. Quin and Collings Bishop questioned the soundness of the chimney foundation, which appeared to them to be resting on the old Roman Road. The former also voiced the merits of the Lancashire boiler, while the latter, together with Mr. Birkett, Burnley, and Dr. Panton, Bolton, found fault with the author's figures.

Mr. Chattock, Bradford, described an alternative arrangement for utilising the syphon action of the return water, in the case of a condensing plant similarly situated to that at Newcastle. The efficiency was about 40 per cent., and there was no turbine to look after.

Mr. Le Rossignol replied briefly, stating that the period for repayment of loans on buildings was 30 years, and on plant 20 years. The mains cost £10,000, and were included in the capital costs, of which the total amounted to £160,000, or, including land, £200,000. The maximum load was 2,920 kw., and the average 800 kw., while the load factor was 28 per cent. The engines were designed for either condensing or non-condensing, and the figures given represented energy delivered from the switchboard.

MANAGEMENT AND WORKING OF BOILERS.

By Horace Boot.

Mr. Boot states that an engineer can gain more experience in five years' life in an electrical station than in 50 years of ordinary industrial conditions. The result of this, as regards the author, is to favour a combination station of Lancashire and water-tube boilers—the latter to undertake the peak loads, the former to take the more steady loads. A table is submitted showing a few prominent figures, according to the author's experience, and we reproduce it herewith because it possesses a value to-day as evidence that extravagant claims for water-tube boilers are not made by men of experience. This table gives the evaporative capacity of the Lancashire and water-tube boilers in use at Tunbridge Wells. The internal measurements of the Lancashire boilers are 30 ft. in length × diameter 8 ft. 6 in., 200 lbs. working pressure.

Boilers.	Babcock.	Lancashire.
Evaporative capacity, lbs. water per hour	4,500	7,000
Grate area, square feet	30	39
Heating surface, square feet	1,468	1,080
Floor space, square feet	147	402
Lbs. water evap. per sq. ft.—Grate surface...	150	180
" " Heating surface	3	6·47
" " Floor space ...	30 6	17 4
Capital cost of boiler and setting... ...	£543	£985
Capital cost of superheater	£90	£132
Total capital cost boiler and superheater...	£633	£1,117
Capital cost of boiler per 1,000 lbs. water evaporated (exclusive of brickwork) ...	£139	£159
Quantity of water in boiler at normal level	1,250 gals.	7,000 gals.
Quantity of water in boiler with water just showing in gauge glass	980 gals.	6,000 gals.
Length of time available in an emergency without feed water at full working load	36 min.	1 hr. 25 min.

The author also appends a set of rules which he has drawn up. We need not reproduce these, as they are but drawn up from ordinary practice in caretaking of boilers. The author advocates full inspection of water-tube boilers every three months: that 6 to 10 gallons of paraffin or soda should be immersed in the boiler before cleaning, for 60 hours, at not above 50 lbs. pressure, and that the water should then be lowered slowly, and each row of tubes scurfed while the water is still in them. The author has devised a special appliance for testing tubes alone one at a time at a high pressure, so as to avoid testing tubes at a pressure undesirable for the steam drum. Thus risky tubes may be discovered, he considers, without over-stress on the boiler as a whole. The appliance is, in brief, a special cap tightened by a set screw, which forces a closer upon the header at the same time as it closes the cap.

The author keeps records of tube renewals on a special tube plan, and generally keeps a log of boiler repairs. He does not find the turbine tube cleaner to be economical of water, and a new tube might be cheaper than cleaning out an old one. The importance of tubes being clean, is shown by the usual table of loss of efficiency due to scale, a table of long standing, which, perhaps, requires further proof of its truth. Air leaks in brickwork are stopped as soon as found. About 10 per cent. of tubes are renewed annually. They are 16 ft. long × 4 ft. diameter, and $\frac{3}{16}$ in. thick, and cost 26s. 6d. to renew, labour included.

The lower tubes give the most trouble, the three lower rows failing by blisters about 6 in. from the bridge. The author prefers wrought-iron to cast-iron headers, though he has not had any actual trouble with the latter.

He uses only oil and graphite for cap joint making, advises mushroom valves and not balls as isolating valves, and recognises the notorious smokiness of the water-tube boiler without explaining the reasons for this fault, though he makes some suggestions on this subject under the head of Lancashire boilers. He recommends 8 in. of fire thickness and a draught of 0·6 to 0·7 in., but does not say where he would have this measured, and he rather mixes up his remarks on the two classes of boilers.

He speaks well of the old style of plastic covering for shell boilers, and evidently is not over impressed with the magnesia mattrass, which is too delicate for boiler purposes. For 12 months two Lancashire boilers cost about £14 each for repairs all told, including fire bars and flue cleaning, being less than half the cost for water-tube boilers of little over half the evaporative capacity. The scurfing cost also is much less than for water-tube boilers.

About 8 per cent. economy is claimed for superheaters. Flooding is condemned, and perfect shut-off of the gases is advised from the tubes when not passing steam. A sketch is given to explain this. Some superheaters we are told still contain cast-iron, but these are not commended, and warnings are given which ought not to be required to-day. Superheaters, too, are made so as to be difficult to renew as regards individual tubes.

The author complains about Tunbridge Wells water, and gives its analysis. He has tried certain trays to catch the scale in the boilers themselves with considerable success.

Mr. Boot's paper shows at once the strength and weakness of the average station engineer. After years of experience, Mr. Boot finds that the water-tube boiler costs about four times as much as the Lancashire boiler in up-keep per unit of evaporation, and this does not include the cost of scaling. But he almost exhibits a novice's experience of boilers in talking so much about cast-iron parts of boilers. Experienced boiler engineers do not parley with cast-iron as a material for boilers. It is to them anathema. They don't tolerate argument on the question, having seen too much of its dangers. Mr. Boot condescends to discuss it—a dangerous precedent which experts cannot understand. They will have none of it. This all shows how our station engineers have been poisoned in their minds by American practice. There was no cast-iron permitted in any important part of a steam boiler at 100 lbs. pressure or over until we were invaded by bad practice from America, and it has taken several years to purge water-tube boiler makers of this cheap and nasty importation.

The author appears also to have found, it may be tardily, that it pays him best to use Lancashire boilers for steady work, and only make spurts with water-tube boilers. The salient feature of the paper is the evident trouble that is experienced with water-tube boilers. They seem to be a constant source of trouble and expense, which is not patent to the author, who appears to look on it all as very right and proper. The very diagram of tube renewals is itself proof of the troubles incidental to the water-tube type. Indeed, the whole paper is an unconscious condemnation of the type by an engineer who appears to give more than ordinary attention to caring for his boilers and to repairing air-leaks in brickwork, and generally attending to points that are often overlooked. Undoubtedly, great loss is incurred when brickwork is allowed to become leaky, and the painting of boiler walls has long been advocated in these columns as necessary to economy.

It seems late in the day to find weldless tubes advocated, seeing that for water-tube boilers the weldless principle has been recognised for years as necessary.

The welded tube and the cast-iron header are both cheap Americanisms that are foreign to English boiler practice, and would never have been tolerated by engineers of experience. They have been foisted upon electrical engineers as correct practice. Nor can a good word be said for malleable dogs for securing tube caps. These also ought to be of steel.

As regards smoke the author recognises that this is an attachment of the water-tube boiler, but he does not state why, nor does he explain that the water-tube boiler can be set smokelessly by anyone who chooses so to do further than referring to the arrangement adopted by Mr. Miller at Kensington, with chain-grate stoker, and a proper combustion chamber. It is, of course, to the proper chamber rather than the stoker that smokelessness is due, and it can be got any time if engineers will spend a fraction on fire-brick of what they now waste in coals.

We certainly cannot agree that radiation losses are so much less with water-tube than with Lancashire boilers, and as regards leakage at the seating blocks, the elastic asbestos rope seating of Pearson's effectively stops this.

The author speaks of combustion, and of fire thickness and draught, but he appears to miss the essential necessary to smokelessness, namely, temperature. Yet he knows what Mr. Miller has done, and surely ought to realise that there is but one true road to perfect combustion, and that this lies before him if he only will follow it.

It seems that electrical engineers have gone backwards in steam boiler practice, and to paraphrase somewhat the author's own words, they have undone in five years of retrogression, all that has been advanced in 50 years of ordinary industry, for they have reinstated cast-iron as a material for boilers, have intensified smoke, and have set up boiler construction on lines so long condemned that examples of failure had existed for years in the museum of the M.S.V.A. before there were any electrical engineers in existence. We think the author is a bit at sea about the boiler insurance companies and reduction of pressure in shell boilers. There are five sources of water at Tunbridge Wells, and he seems to have got the worst of the bunch. Engineers would do well to note his remarks on superheaters, which are good and to the point in respect to flooding, to cutting off the hot gases from the idle tubes, and generally.

In thus criticising the paper we do not wish to imply that it is not of great merit, for it is really a valuable paper, and one that station engineers may study with profit, not the less so, perhaps, because it contains condemnation of certain modern methods of boiler making, which ought never to have been dug out of a dead past to pander to cheap and nasty alien ideas long ago condemned as unfitted to English ideas of safety and durability.

American boiler practice is distinctly inferior. Punched plates are still quite usual, we believe. Cast-iron is not yet dethroned, and the whole status of the boiler as a piece of workmanship is below the practice of this country. It took years of patient industry on the part of the boiler inspection companies to get rid of the grave malpractices of 50 years ago, and just about as soon as a sound construction had been arrived at and accepted heartily by most boiler makers, the professional element among our engineers, captivated by the one idea of small diameter, swallowed the water-tube boiler whole, just as sent over from America, with its welded tubes and cast headers, and even cast ends on steam drums. It has required a full score more years to bring up the water-tube boiler to constructional stability and soundness, and now we have a swarm of superheaters with cast-iron parts to be purged away. Everything seems to tend to degeneration, and it is a curious thing that the teachers of engineering seem least capable of regeneration.

We are glad to see Mr. Boot condemn the practice of superheater flooding, because, though perhaps in itself correct, under certain circumstances, it possesses a potential danger to the engine room.

Obviously, any hydraulic test that can properly be applied to a water-tube boiler drum will be uselessly small to apply to a tube of only, perhaps, one-tenth the diameter and one-third the thickness, and the appliance sketched by Mr. Boot may be usefully employed to test each water tube, especially where these are lap-welded, and therefore liable any day to open out and scald men to death after the manner of safety boilers for a half century back.

It is a curious commentary on the novices' argument for small vessels to contain steam pressure that the one part of the water-tube boiler which has caused no accident is the large steam drum that possesses a diameter over half that of many Lancashire boilers, and is exposed to stresses considerably greater than were claimed not long ago as dangerous in shell boilers.

A discussion of considerable length ensued, in which Messrs. Wilmshurst, Rosenthal, Cooper, Brydges, Ruthven Murray, Hoadley, Maxwell, Quin, Vignoles and Robinson took part. The poor results obtained with the author's water-tube boilers were commented on—it being generally agreed that the bottom rows of tubes might require occasional attention. From the fact that the top rows of tubes were unaffected, Mr. Wilmshurst concluded they were little used, and mentioned a wide boiler, of less height, a proposal which Mr. Rosenthal considered would have the effect of decreasing the retarding action and ultimate efficiency of the boiler. The chain grate stoker, as a smoke curer, seemed to be in considerable favour.

Certain speakers mentioned the difficulty of keeping a thick fire over the whole length of the grate, and trouble with air leakage through the fire—difficulties which, it was stated, had been solved in later types.

Several speakers considered that it was impossible to distort the headers. Messrs. Rosenthal and Quin could not see eye to eye with the author in the utility of his tube-testing appliance, and Mr. Brydges questioned the advisability of testing tubes so often.

Isolating valves were considered a very good thing, and the question of flooding superheaters appeared to be a debateable point, it being mentioned that in the case of a McPhail superheater fitted to a Stirling boiler, the makers provided no means, and specially directed that it should not be flooded.

In the matter of the feed-water, which had proved such a difficulty to Mr. Boot, several speakers advocated the use of a chemical softening plant. Mr. Ruthven Murray considered that the economiser had an excellent effect on oily water. Mr. Vignoles found the Babcock & Wilcox water purifier satisfactory in removing oil. Mr. Quin recommended treatment with hydrated ferric oxide of iron or sulphate of aluminium for the same purpose, and Mr. Hoadley was putting in a chemical filter, not having found the baffle oil separator satisfactory.

Mr. Ruthven Murray used silicon cotton in sheet steel lagging, and lined the outside of his boilers with glazed brickwork, with a view to preventing heat radiation. The importance of using CO_2 indicators seemed to be generally recognised.

Mr. Boot, in replying, stated that his water could not be treated by any process, the only thing was to obtain another source. The Boiler Insurance Companies pay a large sum annually for tube renewals. In regard to the tube tester, he had tried it up to 700 lbs. per sq. in., and he had found it difficult to keep the joints tight with more than 400 lbs. pressure, when testing batches of tubes. He did not consider it surprising that headers were distorted, considering the temperatures to which they were subjected. On the whole, his experience with Lancashire boilers was the happier one. The effects of lagging and its durability could only be judged after years of use.

SOME STATISTICS OF ELECTRICITY SUPPLY.

Aldebman J. P. Smith, J.P., ex-Mayor and Chairman of the Electricity Committee, Barrow-in-Furness, submitted a paper on the above subject based mainly upon the quarterly returns published in the *Electrical Times*. He admits the difficulty and danger of dealing with figures, that with a little careful selection and manipulation can be made to prove almost anything. He also, in reference to the number of provisional orders that have not been worked, candidly states that "almost the whole are in the hands of the municipalities, many of whom, however, it is to be feared are only using them for a purpose for which they were never intended, viz., to keep out a private company."

He thinks this a practice very much to be condemned, and blames the Local Government Board for not trying to stop it, but he appears to be oblivious of the fact that the department he refers to has nothing to do with it. The granting and revocation of provisional orders rest with the Board of Trade, the Local Government Board only coming on the scene when loans are required for putting the orders into operation.

Among the numerous tables of statistics included in Alderman Smith's paper may be enumerated a summary of electricity undertakings, showing that local authorities have 204 works in operation and 104 under construction, against 103 and 36 respectively by companies. The orders obtained and in abeyance are 114 in the hands of local authorities and 19 held by companies. These latter figures justify the Alderman's stricture upon the action of municipalities in taking the powers purely for obstructive purposes.

His second table, which deals with a comparison of the output of municipalities and companies, shows the general progress of the business, but as the largest towns are in the hands of the local authorities, the outputs are, of course, much larger in their case than among companies operating in the smaller districts. In the metropolis the business of the companies is greatly in excess of that of the municipalities, the latest returns of units sold showing 75,531,716 by the companies against 16,539,483 by local authorities.

Table III., dealing with the relative capital outlay by Corporations and companies, was also referred to in the President's address, and is subject to the same objections, viz., that an attempt is made to compare costs without the necessary data; it by no means follows that the best value is obtained, because less cost is incurred per KW. of plant; the difference in outlay for sites by Metropolitan companies, for instance, is not to be compared with the cost of land in many districts, and in some cases no charge for it at all appears in municipal electricity accounts.

Tables comparing costs of production occupy several pages of the paper, and here again the figures depend upon many factors which affect the results.

Alderman Smith dwells upon the price at which current is sold, and claims that the consumers are supplied on better terms by the municipal traders than by private enterprise, and calculates that "had the municipal stations charged the same rates as the companies, they would have enjoyed an increased revenue during 1901, of no less than £444,519, equal to 2·62 per cent. on the capital invested. This appears to us strong evidence of reckless trading, if such figures have any value—which we question—as municipal trading in electricity supply cannot be shown to have paid, and the companies have had to be content with very moderate dividends considering the nature of the business.

The interest and sinking fund is the great bugbear of Alderman Smith, and his paper deals fully with it. He cannot see the way to further substantial reductions in price owing to the abnormally heavy payments on this account, and one cannot but sympathise with him in his agonising reference to the heart of a chairman of Committee, of which he says if it is not "too hard to receive any impression at all, surely these three fatal words would be revealed by a post-mortem examination," viz., *interest* and *sinking fund*.

The author points out how the gross profit is swallowed up by these items, and is appalled by the relation they bear to the total costs. He refers to variation in practice as to the sinking fund—which ranges from 25 to 62 years—and advocates a longer period for repayment of loans, and a deferred period for commencing to provide the sinking fund.

The discussion was opened by Mr. Chamen, who remarked that statistics could be made to prove anything, but in this case he thought they were unbiased. From reading the author's comparison of the gas and electricity revenues at Barrow, he had been led to compare the coal bills of the two undertakings at Glasgow, and found that in the case of the electricity works it amounted to 12 per cent. and the gas department 40 per cent. of the total revenue, so that, he thought, would leave them something to draw upon.

Mr. Vesey Brown expressed the opinion that as the Municipal Committee had six months in which to meet their shareholders, as compared with only seven days in the case of a company, it was possible in the former case for the shareholders to forget. He remarked on the number of provisional orders which were being transferred to companies. Mr. Brown found himself unable to swallow the comparative tables contained in the paper. They were misleading, did not contain sufficient information, and he was convinced that the companies were all that is good. They had done their duty to their areas of supply and given equal chances; they would come out as good, if not better, than their rivals. He strongly criticised the proposal to diminish the interest and sinking fund, and urged the desirability of not forgetting depreciation, also advancing the novel theory that companies paying large dividends were enabling their shareholders to provide a depreciation for themselves. His closing thanks for having been allowed to help the discussion were received with laughter.

Major-General Webber claimed that companies are not placed on the same basis as corporations in the matter of rating, and in the charges for road disturbances. The local authority never rates the private undertaker the same as itself. On the matter of capital expenditure, he reminded his hearers that the companies were the pioneers, and had expended large amounts on distribution networks.

Bailie Willock, Glasgow, defended the municipal conception of depreciation, and denied that the assessments on their electrical undertakings were in any way biased. In Glasgow they did not believe in appropriating the surplus from the gas and tramways undertakings for the relief of the rates, as it would be unfair between workman and the more wealthy ratepayer, the latter obtaining the large reduction in rates, while the former used the trams to the greater extent.

Bailie McKenzie, Edinburgh, could not see how the interest and sinking fund were to be reduced, he thought that a year or two's grace at the beginning was all they were entitled to. He also favoured the formation of a reserve fund in preference to depreciation, disagreeing with the placing of profit to the relief of the rates. He deprecated comparisons between companies and corporation, and did not think it reasonable to expect greengrocers to be the equal of company directors in administrative powers.

This brought Councillor Scott, York, to his feet, with a suggestion that if company directors would do their duty on muni-

cipal councils, they would, doubtless, manage better than small tradesmen. In every respect the municipalities were better than companies. He contended that companies paid large dividends to raise the price of their shares, and not as suggested to provide for depreciation. In York they paid more for reinstating the roads than the local gas company, and were not favourably rated.

Dr. Panton, Bolton, considered that municipalities were in a far better position than the companies in regard to reserve. He also agreed with the other municipalists as regards rating, and thought that a depreciation fund should be provided, as it could not then be taken for any other purpose.

Mr. Madgen, on the invitation of the President, proceeded to sit on municipal worshippers generally. The tenor of his remarks was a vindication of company directors and their work; that many municipal advocates were young and ignorant; that Mr. Smith's figures were misleading without further particulars as to the distributing areas. He remarked that many Corporations had reaped the benefits of pioneer work carried out by the companies in undertakings they had taken over, and he thought that every credit was due to the engineers in small towns who made them successful rather than to certain self-satisfied Councillors from a larger city which would offer every chance of success.

Councillor Dowson, Doncaster, thought that no company undertook to supply in an unprofitable area, and Alderman Coutts thought that the statistics proved the municipalities to be in the better position.

Alderman Smith, Barrow, in replying to the criticisms, adhered to the figures given in his paper. He regretted the controversial nature of the discussion, and expressed his surprise that Mr. Madgen should have contested figures which were taken from a journal with which he was once associated.

THE POSSIBILITIES OF FUTURE ECONOMIES IN ELECTRICAL ILLUMINATION.

By W. A. Chamen.

The revenue of electrical undertakings will not be reduced, but increased, by improvements and increased efficiencies in lamps.

The ordinary incandescent lamp takes from 3½ to 4 watts per candle, and there seems little probability of improvement. The "Crawford-Voelker" lamp brought out some 12 months or so ago, and for which a high efficiency was claimed, appears to have been dropped.

The Nernst lamp, of which it is said there are about 10,000 in use in Glasgow, effects a very considerable reduction in the consumption of energy for an equivalent amount of light as compared with incandescent lamps; an average life of 600 hours may be reckoned upon. Assuming that a 1 ampere 250-volt Nernst lamp gives as much light as eight lamps of 16 c.p., the relative amounts of energy consumed in 800 hours, the useful life of an incandescent lamp, will be 409 and 204·5 units respectively.

The cost for incandescent lamps will be, at 4d. per unit, £6 16s., plus renewals, say 8s., a total of £7 4s. The cost for the Nernst will be £3 8s., plus cost of renewals, 4s. 8d., making a total of £3 12s. 8d.

As such materials as are used in incandescent gas mantles and Nernst lamps give off a brilliant light when heated to a moderate extent, there is no apparent reason why some combination of carbon and one or other of these materials should not be evolved to combine instantaneous lighting with high efficiency.

The Hewitt mercury vapour lamp gives 1 c.p. with a consumption of energy of half a watt, but, owing to the absence of red rays in the light, it cannot be used for indoor illumination. The use of red glass does not, of course, improve matters, but makes them worse. It would seem possible by means of combination, that is to say, by mixing something with the mercury to produce a light having red rays in it. The lamps can be made to work at any pressure from 50 to 500 volts, but a high pressure is needed to start it. This is obtained by means of an induction coil. There is practically no limit to the life of the lamp, but it requires opening and washing out every 1,200 or 1,400 hours.

Turning to arc lamps, we find by mixing various substances with the carbon the nature of the arc is completely altered. Thus in the Bremer and other patterns of "flame" lamps, the arc is prolonged and the colour of the light modified, an orange tint being the most satisfactory. The efficiency of the light is very largely increased, the consumption being decreased to about a quarter of a watt per candle. The consumption of carbon is greater than with ordinary arcs, necessitating more frequent trimming, and the light is not quite steady owing to the longer arc.

Although giving a greater efficiency than ordinary arc lamps, the flame lamp has not yet been made to take a smaller current, the difference being in increased light.

Another departure in arc lighting is the "very small current" lamp, taking about 1 ampere, burning either with an open or enclosed arc. No actual experience regarding the cost of maintaining these lamps appears to have been gained, but, taking into consideration the cost of trimming, &c., it does not seem probable that it will beat the Nernst.

The enclosed arc lamp has done good in spurring makers of open-type lamps to produce long-burning lamps. Open lamps burning 60 hours can now be obtained, and an 80-hour lamp is rumoured to be forthcoming.

The conclusions are, that the possibilities of future economies in electric illumination for all purposes are considerable, and that we may hope to see the consumption of energy for a given amount of light cut down to about half the present figure.

It is a good thing that electrical engineers should thus encourage at the outset every improvement in lamps or other current-consuming device, and recognise that this, by popularising electricity, will, in the long run, mean increased revenue to the supply company. The gas companies were somewhat slow to appreciate this fact, and, at first, were opposed to improvements in gas burners. They have, however, learned by experience that every improvement is to their advantage.

The comparison Mr. Chamen makes between a Nernst 250-watt lamp and eight lamps of 16 c.p., is hardly fair to the incandescent lamp; he should have taken a 250-watt incandescent lamp, when the comparison would have been much more favourable to the latter.

Otherwise there is little to criticise in the paper, except Mr. Chamen's repeated expression, "A consumption of energy" of so many "watts per candle."

SOME SUB-STATION DANGERS AND THEIR PREVENTION.

[communicated.]

Though danger of life and limb to the electricians in charge of converting sub-stations is happily nowadays very slight, it is nevertheless not a negligible quantity, and a few points that may help to still further reduce the chance of accident may be deemed worthy of consideration.

In the first place there is the danger of the rotary sparking across at the brushes owing to any sudden surge in the high tension voltage. This, of course, cannot be prevented, and the only way is to keep a reasonable distance from the commutator while the machine is on load; in this respect, lubrication of the commutator with paraffin wax should not be encouraged, as it tends to help arcing, especially if there happens to be a hunt on at the time. In our own experience we have seen bad burns received in this way, the flash occurring while the attendant was examining the lubrication of the carbons, and striking him full in the face, taking off the skin and burning away the hair.

Then the terminals of the machine should certainly be covered with a wooden box at least (such a box can be made quite ornamental in a simple way). Usually the positive and negative terminals, consisting of flat rectangular blocks, lie quite close to each other, and it is the easiest thing in the world to lay a spanner or a file across them in an unthinking moment, or perhaps some such tool has been placed on a machine not running, and on starting up has lain unnoticed, with the consequence of a dead short and attendant evils.

While on the subject of the rotary itself, a few further practical points may be of interest.

In one case, in order to soften the brushes and ensure continuous lubrication and silent running, resort was had to boiling them in castor oil for several hours. This plan was at first satisfactory, but the carbons soon began to give trouble by heating and burning away at their rubbing surfaces. The oil also became troublesome by oozing out, due to this heating, causing the carbons to stick to the brush-holders, and when in course of time they had to be removed, the greatest difficulty was experienced in getting them out of their holders; the oil seemed to form into a hard dry cement which stuck tenaciously to the brass, the consequence being that it took several hours of hard chipping to get them shifted. This lubrication is, however, unnecessary, for by setting the brushes at the proper angle, and by careful attention to the regulation of pressure, they can be made to assume a glass-like surface, and require practically no attention at all. Another point is the use of an arrangement whereby the brushes on the slip rings can have their pressure varied by an easily get-at-able screw instead of having to undo nuts and bolts.

A danger that is always (or very nearly always) neglected, is the bringing of brass knobs through the switchboard panels from the iron supports behind. These knobs are always in good connection with earth, and the danger lies in the fact that careless or accidental connection with the switches by a metal tool sometimes occurs, with the inevitable short, as the switches are less than a foot away. No doubt a very fine polish can be put upon these knobs, but in the interests of safety they should be capped with ebonite or other insulation. Such a cap, occasionally seen, is susceptible of a high polish, and, though of a dark colour, does not affect the amenities. We have seen such a short as that described, with bad burning as the result. Another source

of danger is the heating of the secondary switches through faulty connection with the jointing behind: a high resistance is set up, and in bad cases a very high temperature is developed.

The boosters need careful looking after, as it is rather hazardous to have the terminals of a machine alive that is not on load (the booster, rotary, and induction motor are here assumed to be on one shaft). The remedy is, of course, the removal of booster plugs from the panels of all machines not on load; and while on this subject we may say that the method in vogue of screwing in the plugs is certainly rather clumsy and awkward, to say nothing of the wearing away of the thread due to the weight of the plugs while being inserted. The operation, too, is rather a long one. Surely a system of switches might be used with advantage.

Again, there is always the chance that the carbon on the breaker may fly out when the latter is suddenly released. This point needs careful looking after, as we have seen a carbon block thus fly and very nearly strike the operator. In dusting the panels, on the high tension side at any rate, one hand only should be used, despite the fact of the rubber matting beneath; while any unnecessary touching of the voltmeters should be discouraged.

In lubricating the slip rings a longer stick might be employed than is generally in use, to ensure safety from an unexpected earth.

In connection with outside work, in section pillars, &c., it is of importance that all interconnectors should be tested before the switches are pulled out: for though such interconnectors be assumed dead, nevertheless cases have occurred when they were alive through previous faulty manipulation. We have heard of a very bad burning accident occurring recently through the pulling of a live interconnector understood to be dead. Again, the springs in the switches seem in many cases to rot or oxidise away, with the consequence that such switches are practically useless in case of emergency.

A complete outfit of medical necessaries should be at hand in every sub-station, while the address of the nearest doctor should be plainly and *legibly* written above the medical cabinet.

SELECTION AND TRAINING OF MOTORMEN AND CONDUCTORS.

We have nothing but praise for the methods outlined in a paper bearing the above title, read by Mr. Mackinnon at the Glasgow Tramways Convention, and we can confidently recommend them for earnest study to the heads of the unfortunately large number of tramway undertakings, where both the careful selection and thorough training of the men who will be responsible for the smooth running, public convenience, and safety, of passengers is performed in a short-sighted and slovenly manner.

Glasgow cannot, and presumably does not, claim that these methods originated within her bounds, for they are largely, if not entirely, based on American models; but she may well claim considerable merit for the immediate and thorough adoption of the methods when conversion to electric traction began, and in this she has given a lead to English towns.

When occasion has offered, we have referred to the excellent training given in Glasgow, and we have not failed to urge the adoption of the same principles throughout the country, and this paper gives us another opportunity to reiterate our gospel of efficiency.

There is no particular reason (so far as we are aware) to think that the type of applicants for tramway employment in Glasgow differs to any extent from the general average throughout Britain, and it is most instructive therefore, and most ominous also to learn that in Glasgow not 20 per cent. of the applicants reach the platform of a car in an official capacity! In fact, Mr. Mackinnon states that 75 per cent. are rejected at sight almost, while only 40 per cent. of the remainder survive the full series of tests and examinations; but we heartily endorse the author's closing sentence that "there is no doubt the stringency of the examination before admitting men to the service has tended towards getting a better class of men into the department, and it has also had the effect of making those who secure situations value them more highly." Particular attention is drawn to the latter part of the sentence, which we believe is sufficient answer to the kind of man who gives as his reason for not training to the highest useful pitch that a highly trained man is independent of his job and cannot be depended on to stay in the service; that, in fact, money would be spent on training men for other undertakings. The fallacy of this anti-educational theory must be obvious to every open-minded and experienced manager. There are, of course, managers who cannot keep good men, whether these are trained or untrained, but they will not be touched by an infinity of papers and articles. It matters not whether we are dealing with an individual or with a business undertaking or with a nation; the proven truth must hold that prosperity comes with education; and education, whether of the unit or of the mass, cannot be attained without, first of all, intelligence to assimilate, and then time and money and trouble.

Managers should remember that while the Unions every year are enforcing more strictly a standard wage, or a standard scale of wages, for the various grades of tramway employés, they are not yet controlling the admission of men to the service, so that, the wages being good, it behoves every manager to get his money's worth; and we have every confidence in asserting that the average value of the staff is below par value wherever selection and cultivation are not utilised to the fullest extent. Neither can we admit the plea that—without excessive expense—it is impossible to attract the right kind of man, and that selection must needs be limited or neglected altogether. The manager who puts forward such an excuse for a slovenly set of inefficients stands condemned either of an improper appreciation of the problem, or of sheer inertia.

An abstract of the paper follows:—

SELECTION AND TRAINING OF MOTORMEN AND CONDUCTORS.

By L. Mackinnon, Traffic Superintendent Glasgow Tramways.

The efficiency of the service depends on the manner in which the motormen and conductors carry out their duties, and the management is judged by the standard of efficiency which is shown by these men.

In Glasgow the bulk of applicants for situations are seen at a fixed hour, but it has been found of great service for the traffic superintendent to, as far as possible, hold himself in readiness to interview likely applicants at any time during business hours.

Roughly speaking, three applicants are found to be unsuitable for every one whose application is worth considering, and out of those whose applications are considered only about 40 per cent. are finally accepted, and enter the service of the department.

In connection with the department there is a flourishing friendly society, with a membership of 2,500. A circular, giving particulars of benefits to be derived from this society (to which the department contributes), is handed to men when they enter the service, and the medical examination for entrance into the service is made to cover admission into this society. Membership is, of course, optional. The medical examination is of a very thorough nature. This is in the interest of the society as well as the department, as a superannuation fund is now being accumulated, so that members of the friendly society who have served for 15 years and upwards in the department may, on becoming unable for work, receive a substantial weekly allowance.

When the traffic superintendent considers that an applicant, from his general appearance and from his replies to a few preliminary questions, will make a good servant, he hands him two schedules to be filled up in the applicant's own handwriting. The first schedule, or application form, requires the applicant to give particulars of his employment for previous five years. The second or supplementary schedule requires the applicant to answer questions relating to his general health and antecedents.

During the forenoon he is tested by one of the officers of the traffic department for eyesight, colour sense, hearing and general intelligence.

Should the applicant get through all these tests, he is put under training as a conductor for eight days, during which period he is paid full wages. The best qualified conductors at each depôt take charge of the learner and train him carefully in his duties. At the end of his period of training, if satisfactory, the probationer's practice note is signed by the men who have been teaching him, and he undergoes an examination by a ticket inspector, who also signs the practice note, if satisfied.

After a period of satisfactory service as conductor—generally about six months—each man is withdrawn from the cars and put under training as a motorman.

In Glasgow a fully equipped school for training motormen has been fitted up at the Coplawhill Car Works, where the men are trained by an experienced engineer.

The class in the school generally consists of 12 or 15 men. From 25 to 30 per cent. fail to pass the necessary examination. Each man is supplied with instruction book, and during his first three

days' tuition he attends the school. On the first day the instructor carefully explains the use and action of the various appliances fitted on the car, and shows how the mechanism should be operated. Learners are also drilled by means of the fixed controllers and brake spindles already referred to, and the correct manipulation of the handles is explained, particular attention being paid to correct methods of acceleration and braking of cars for service and emergency stops.

On the second day the men are taught how to detect common faults in the car equipment, and also what to do in the event of any breakdown in the electrical apparatus or overhead gear. On the afternoon of the second day all the points taken up are again gone over and a preliminary examination made to see how each man is progressing.

On the third day the class is taken out to Coplaw Street, where a depot connection with a considerable grade has been laid. Here the men are tested on a special school car fitted with magnetic and rheostatic brakes. Each man is carefully coached in running the car both backwards and forwards, and every possible care is taken to instruct the men in all points relating to practical operating of the cars. Men are also taught to handle live wires and how to make them "dead" when necessary.

For the next four days—that is, on the fourth, fifth, sixth, and seventh days—the learner is out on the road under the care of an experienced motorman, who has, after examination, been authorised to instruct learners. He here learns to handle the car through traffic. The learners are frequently visited on the road by the motor-inspectors, who make notes of the progress shown, and report to the chief instructor.

On the afternoon of the seventh day the learner goes back to school for a preliminary examination in his knowledge of car details and platform duties, unsuitable men being rejected and returned to conducting. The next three and a half days are again spent on the road, under an experienced motorman, and special attention is given to those men who have shown signs of nervousness or carelessness. The afternoon of the twelfth day is taken up with an examination conducted by the chief instructor at the school, when suitable men are passed, and their lines forwarded to head office.

A system has been instituted in Glasgow of examining each motorman or motorman-conductor once every three or four months, and men who fail to answer questions satisfactorily at this examination are withdrawn from the list of motormen. These periodical examinations are absolutely necessary on a large system, as it is impossible for the superintendent otherwise to get at the undesirables. Some men who qualify will forget all they have learned within a very short time.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"Electric" writes:—"I should be greatly obliged if your legal contributor would give me some information on the following:—We have an electric plant supplying our stores and yards, and we want to carry the wires to supply our offices, which are about 80 yards distant; to get at these, we should have to cross over the public road. Should the Corporation refuse to let us cross over the road, can we cross without their permission, and what height should we have to suspend the wires from the road? There are other business premises between our stores and offices, but we can get permission to cross these premises."

*** The question propounded by "Electric" is one to which we have frequently been asked to give a reply. It is provided by Sec. 4 of the Electric Lighting Act, 1888, that where any electric line or other work may have been laid down or erected in, over, along, across or under any street for the purpose of supplying electricity, or may have been laid down or erected in any other position for such purpose in such a manner as not to be entirely enclosed within any building or buildings, or where any electric line or work so laid or erected may be used for such purpose otherwise than under and subject to the provisions of a licence, order, or special Act, the Board of Trade, if they think fit, may, by notice in writing under the hand of one of their secretaries, to be served upon the body or person owning or using or entitled to use such electric line or work, require that such line or work shall be continued and used only in accordance with the regulations prescribed by the Board. It follows from this provision that the Board of Trade regulations must be consulted before the wire in question is erected. A copy of these regulations may be obtained from the King's Printers. The question whether our correspondent will have to obtain the leave of the Corporation is one of greater difficulty, and cannot be answered without reference to the bye-laws in force. We may observe that in England, so long as a wire suspended over a highway does not interfere with the traffic, and the freehold of the highway is not vested in the highway authority, wires may be suspended if the consent of the landowners on either side is first had and obtained. The right to interfere and prohibit the use of overhead wires can only be conferred upon the local authority by Act of Parliament.

It will be seen from the foregoing observations that a full answer can only be supplied to our correspondent's question after reference has been made to the statutes and bye-laws affecting the district in which he lives. If he desires to bring matters to a head as between himself and the Corporation, he need only put up the wires at a safe height above the surface of the road. If the Corporation desire to remove them, they can only do so under shadow of some legal right.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

14,913. "Improvements in electric arc lamps." E. J. Murphy and A. Townsend. July 6th.

14,923. "Improved apparatus for electro-mechanical massage." E. Adams-Randall, trading as Eva von Hoffman. July 6th.

14,940. "A device for indicating or preventing the exceeding of specified speeds on dynamos, motor-cars, and the like." E. Neuberg. July 6th. (Complete.)

14,963. "An improved electric furnace." P. R. J. Willis. (E. A. Sjosted, Canada.) July 6th.

14,979. "Improvements in electricity meters." H. Aron. July 6th. (Complete.)

14,980. "Improvements in electricity meters." H. Aron. July 6th. (Complete.)

14,994. "Improvements in or relating to a process and apparatus for obtaining a continuous electric current from a high tension alternating current source." A. J. Boult. (F. J. Koch, Jun., Germany.) July 6th. (Complete.)

15,048. "Electric signalling apparatus for railway trains." A. Bonemeyer. Dated July 7th. (Complete.)

15,059. "Improvements in electrical hauling apparatus." Siemens Bros. and Co., Ltd. (Siemens & Halske Actien Gesellschaft, Germany.) July 7th. (Complete.)

15,060. "Improvements in or relating to the manufacture of galvanic batteries." W. P. Thompson. July 7th.

15,065. "Improvements in keyboard telegraphic transmitters." M. Kotyra. July 7th. (Complete.)

15,076. "Improvements in circuit make-and-break apparatus for electric induction coils." L. Legoy. July 7th.

15,077. "Improvements in apparatus for telephone exchanges." A. P. Hanson. (Date applied for under Patents Act, 1901, July 7th, 1902, being date of application in United States.) July 7th. (Complete.)

15,089. "Improvements in electrically-lit signboards and the like." G. Smith. July 8th.

15,090. "Improvements in insulators for electric telegraph, telephone and other line construction." C. A. Randall. July 8th.

15,142. "Improvements in electric apparatus for use in medicine and surgery." A. Goldschmidt. July 8th.

15,186. "An automatic electric welding machine." S. Z. de Ferranti. July 9th.

15,199. "Improvements in induction coils for the ignition apparatus for motors." Marconi's Wireless Telegraph Co., Ltd., S. W. Ashley and K. A. Hinde. July 9th.

15,212. "Manufacture of soda and caustic potash chlorine and hydrochloric acid by electrolysis of aqueous solutions." J. Heibling. July 9th.

15,217. "Improvements in apparatus for varying electrical resistance." G. L. Hogan. July 9th.

15,218. "An improvement in or relating to electric out-outs, contact breakers, meters and similar electrical apparatus." H. Swanton. July 9th.

15,243. "Improvements in means for automatically regulating electric currents generated by dynamos." S. Watkins. (The Consolidated Railway Electric Lighting and Equipment Co., United States.) July 10th.

15,247. "Improvements in electric incandescent lampholders." H. M. Darrah and L. A. Hackett. July 10th.

15,257. "Improved means for operating the rail and condition points in electric tramways or railways." W. Millar. July 10th.

15,266. "Improvements in electrical switches." C. M. Dorman and R. A. Smith. July 10th. (Complete.)

15,364. "Improvements in bars for protecting the openings in electric lift cars." W. Sprowson. July 11th.

15,369. "Improvements in and relating to the operating cords of the trolley arms of electric tramways." A. Taylor, W. Moorehead and T. H. Kingscote. July 11th.

15,420. "Process for the electrolytic production of zinc." K. Kaiser. July 11th. (Complete.)

PUBLISHED SPECIFICATIONS, 1902.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

11,081. "Improvements in apparatus for automatically starting and stopping electric motors." The British Thomson-Houston Co., Ltd. Dated May 14th.

12,671. "Improvements relating to telephone systems." C. G. Burke. Dated June 3rd.

13,488. "Improvements in electric railway systems for parcels and the like, with operation of the cars." H. H. Lake. (Communicated.) Dated June 13th.

13,787. "Improvements in electric railways on a sectional conductor system, and in signals therefor." E. W. Farnham. Dated June 17th.

15,271. "A new or improved process for the electric heating and refining of metals and other substances." C. H. Meller. Dated July 8th.

17,002. "Improvements in the manufacture of conducting materials for electricity applicable more particularly for use in the rubbing or sliding contacts of dynamos and electric motors." V. Lowendahl. Dated July 31st.

17,260. "Improvements relating to electric lighting and to the apparatus therefor." H. Mc Gellwray. Dated August 5th.

17,708. "Improvements in signalling by electro-magnetic waves." R. A. Fessenden. Dated August 12th.

17,923. "Electric arc lamp." J. A. Rignon. Dated August 14th.

17,924. "An improved electric igniting candle for explosion motors." H. Luthy. Dated August 14th.